APRIL 20, 1959

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R&D Research and Development news issue

Product Engineering

McGRAW-HILL MAGAZINE OF DESIGN, RESEARCH AND DEVELOPMENT

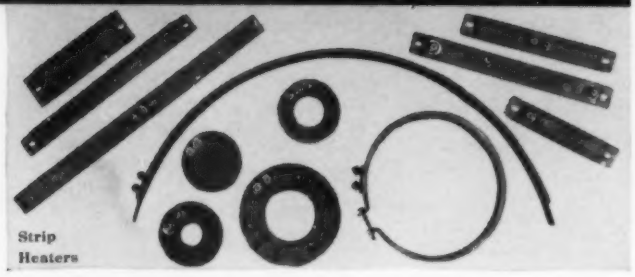
Once mechanics cut-and-tried; now it's planned R & D

see page 23

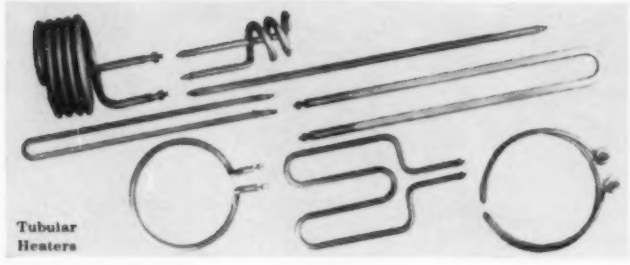
WHAT HAPPENS TO PATENT APPLICATIONS?

see page 33

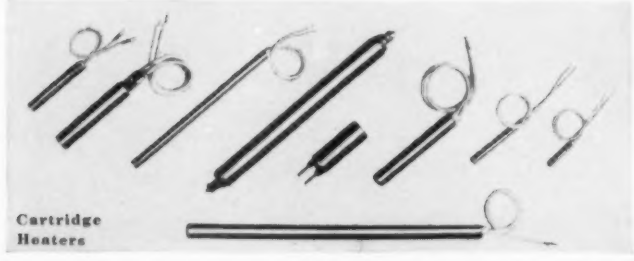
Call your CHROMALOX Man for the heating answers



Strip Heaters



Tubular Heaters



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This issue has a cover somewhat different from our usual one—of broader interest to the engineer as a person rather than as a function. It is another in our continuing efforts to produce a better magazine for you. Now . . .

will you help us?

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—The Editors

I prefer a cover with: a 4-color picture ☐
a 2-color sketch ☐
a special design ☐
a contents-in-brief ☐

I want covers that: show engineering detail ☐
show engineered products ☐
feature engineering functions ☐
picture the news ☐

I think the cover should: list some inside articles ☐
tie in with a long article ☐
be primarily interesting ☐

I see every cover ☐ I never notice the cover ☐
I usually read the cover story inside ☐ I never do ☐

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NAME (optional) ..... TITLE (please) .....

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coming next week

the DESIGN issue for April 27

FEATURING

Piezoelectric transducers
What you should know before putting them to work measuring forces, pressures and accelerations.

Nonmetals for conveyor belts
How they are made, their advantages, and how they may be used for built-in service.

A test for oxidation resistance
New technique peers under the surface oxide for clues to alloy performance to 2300 F.

How to put more into your spun parts
Power shear spinning requires new concepts for best design. Here's how—from simple to complex parts.

Numerical integration for dynamic systems
Tabular method analyzes a mass-spring system and the flight of a rocket.

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12 wire guides
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R and D Research and Development news issue

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● **The bronze punch press** (see cover) is one of the granddaddies of plant equipment (p 23). It was dedicated to mechanics just 60 years ago, in 1899, and commemorates Peter Donohue, founder of San Francisco's first iron foundry, its first street railway and its first gas company. Until the end of the 19th century most inventions were patented by mechanics (p 33). Today newer disciplines must be mined to produce a useful idea (see p 52) for some military needs.

● **None of our commentators mentioned women** in the pre-employment testing of engineers (p 40) but there is no question of the ladies' increasing interest in engineering as a career. This is even more true outside the US. Our London bureau notes a British government publication report that a Chinese tugboat now under construction in a Shanghai shipyard was entirely designed by more than 100 women. Says our bureau chief there, "If that one doesn't come up more camel than greyhound, I'll buy you a ticket to the next commune meeting."

● **A segment of the reading public** (readers of the *Saturday Review*) were questioned in December 1957 to see what they thought about man in space. Relatively well informed in the scientific facts as we know them (80% could name 7 planets), they were far more enthusiastic about space flight than were those studied by U of Michigan researchers (*PE*—Apr 6, p 4). Of respondents under 20 years, 85% were in favor of putting a man in space; 20-40 years, 78%; 40-60 years, 75%; over 60 years, 61%. Those against spaceflight varied from 9% of those under 20, to 24% of those over 60. By occupation, the least enthusiastic were clergymen, doctors, lawyers, teachers and other professional service people (72% for spaceflight). Professional scientists and humanists (writers artists, etc.) were somewhat more encouraging (80%). Seems the more authoritarian the education, the less adventurous the spirit.

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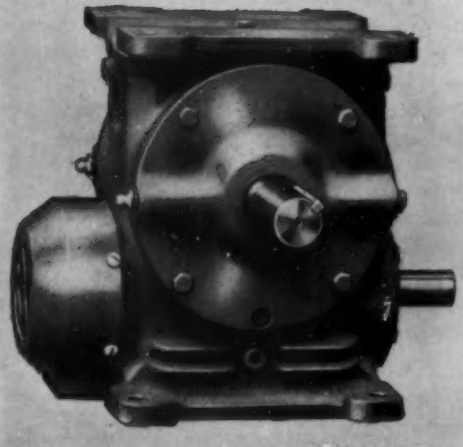

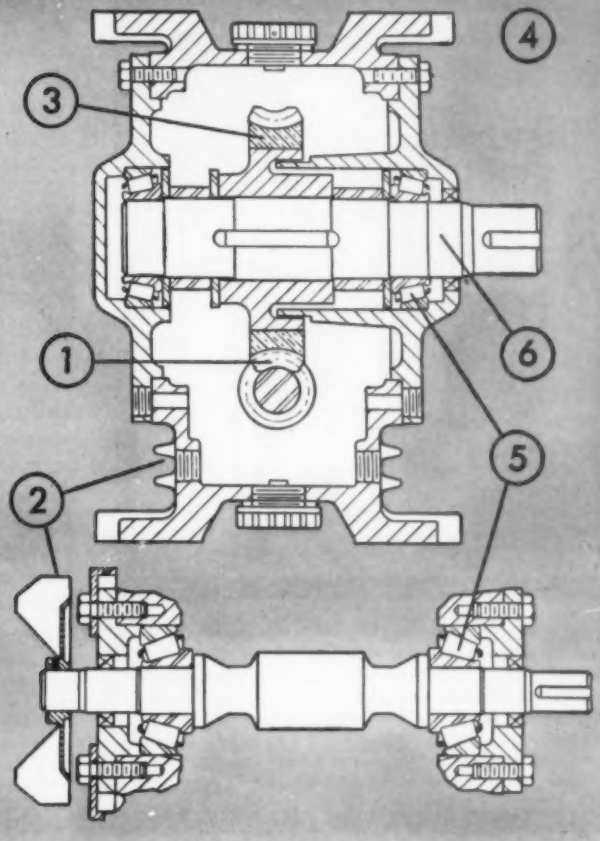

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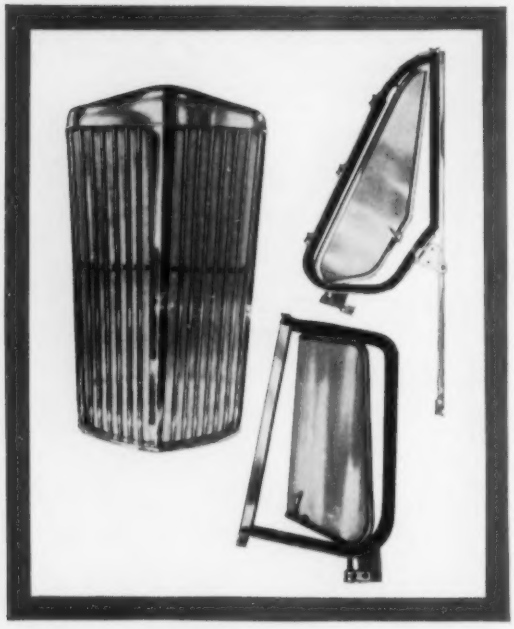

The high strength-to-weight ratio of stainless steel permits the use of slimmer channels and frames in passenger car and truck sash. Protected by stainless, glass breakage is less likely. Strength, dent-resistance, and corrosion-resistance make stainless ideal for radiator grills. Manufacturer—Excel Corporation, Elkhart, Indiana.

Always right, always bright stainless steel, the optimum metal for trim and brightwork, is showing up in ever-increasing functional applications.

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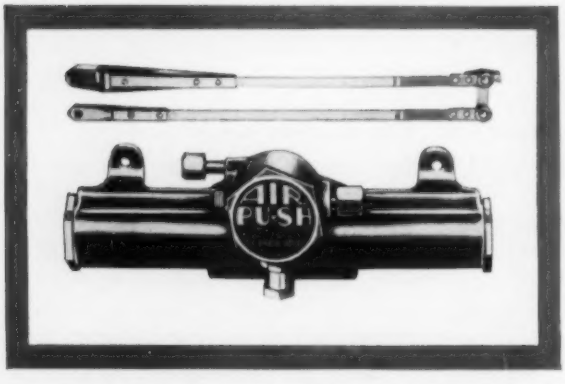
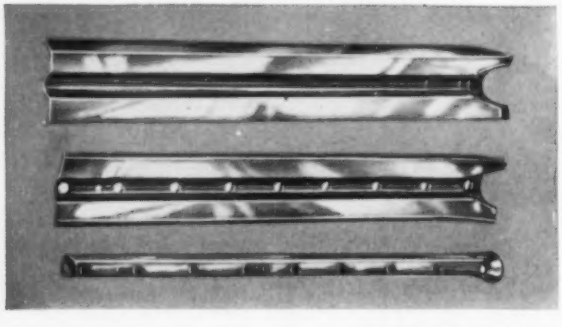
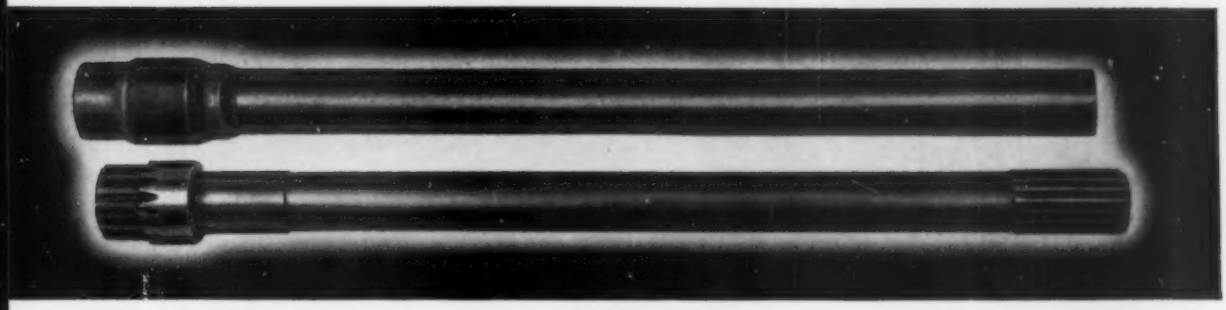


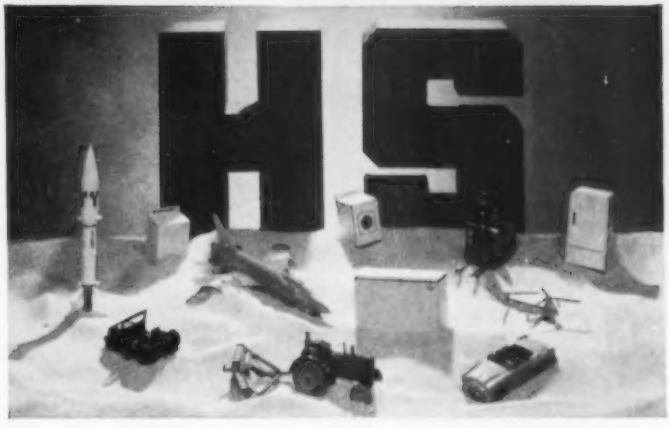
Stainless steel makes an important contribution to the safe operation and maintenance of windshield wipers. Stainless steel's strength assures resistance to breakage or distortion. Light, strong design reduces dead weight that the wiper motor must move. Elasticity of stainless gives the blade the proper pressure on the glass. The wiper arms are protected against the slow and insidious weakening effects of corrosion. Manufacturer—Sprague Devices, Inc., Michigan City, Indiana.



Formability, corrosion-resistance, and cost were prime factors in switching to stainless steel from brass in this engine water distribution tube. Stainless was easily fabricated on existing tools. It took the constant flow of hot water and anti-freeze chemicals in stride. The greater strength of stainless virtually eliminated loss from bent or damaged tubes. Photo sequence shows fabricating operations: (1) Blank of .010" stainless strip after initial drawing and embossing, (2) Same blank after piercing of water outlet holes trimming of flanges, (3) Completed tube after roll-forming and lock seaming. Produced by Pontiac Motor Division of General Motors Corporation.



NEW FABRICATING PROCESS MEANS ECONOMY. Ford Tractor power take-off countershafts cost less to produce using Republic Die-Form blanks, as compared with previous materials. Blank is shown at top, completed shaft below. Die-Form is a new method of cold forming hot rolled carbon, alloy, or stainless steel bars into multi-diameter blanks ready for final machining. Because Die-Form blanks closely approximate the completed part, scrap losses are negligible. Improved machinability permits savings through use of higher speeds and feeds. Mail coupon for complete facts.



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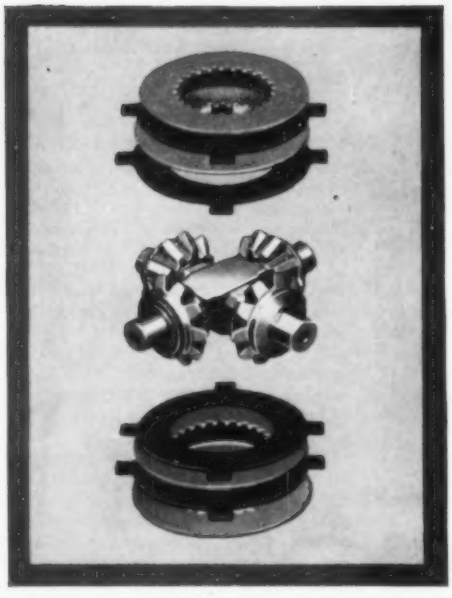

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Reader To Editor...

The Race That Doesn't Fit

To the Editor:

Lour article "One Man Engineering Firm" of Feb. 23 (p 30) is excellent, and hits I am sure, both the blessings and bugaboos associated with "lone-wolfing" it, but gets across the atmsophere of excitement to be had for those who like it this way. I am sure of the "race that don't fit in," and have set myself up as an independent engineer.

I can't conceive of any but the top or special few commanding $150-200 per day, yet you call this about average. A few years ago a company in which I was employed hired the president of a gear standards association, who was an expert in his field, and who put in a long hard day for $75.

One client, who formerly employed me, says "We occasionally hire consultants at $100 a day, but not for many days." Another potential client where I have a good friend says "They can ask for $150-200, but I don't think they will get it."

—Morton P Matthew
Model Engineering
Norwalk, Conn

To the Editor:

Most of what you have written is so true to life that I almost felt you had been looking over my shoulder these past couple of years. However, you tossed out one statement so nonchalantly I doubt that you realized it was loaded. I refer to the paragraph concerning the consultants, "who have invented a specialized device. . . . In some cases the consulting service functions mostly as a sales gimmick. If the application calls for it, he may recommend his patented device and offer to custom-tailor it to the job."

This practice is considered so unethical that in many circles practitioners of it are not considered consultants! For example, the Consulting Engineers Institute of Wisconsin restricts membership to those who derive their major source of income from the practice of consulting. Anyone combining so-called consulting with another source of income, such as manufacturing or sales, is not eligible for membership. The underlying thesis being that a consultant with a side interest, especially a sales incentive, is incapable of rendering an unbiased opinion or judgment based on professional standards alone —particularly when that judgment resolves around "hardware" which the interested party purveys.

Not only does the ethical standard enter the picture, but there is the consideration that an engineer or scientist of a caliber qualifying him to be a consultant is not apt to want to fool around with selling or manufacturing hardware. He is too engrossed in his professional work.

I observed with gratitude the point you made about the cost of consulting—the fact that a staff-engineer costs over twice his hourly rate is often, usually, overlooked. Whether it is an honest oversight or a matter of price chiseling, one of the most difficult problems the small operator has to contend with is that of having his rate compared with the hourly wage of the employe. When you stop to realize that the cost to a company of a $600/month engineer is at least $7/hour, the cost of consulting services is not excessive. There are very few engineers or scientists in the consulting field that could be hired for $600/month—most of them would get $10,000-15,000 a year. This is $9.63 to $14.45 per hour.

—Russ Henke
Elm Grove, Wis

Metric System Confusion

To the Editor:

In the Mar 23 issue, p 30, six presidents and directors gave their views on the feasability of adopting the Metric System. Allow me, as an immigrant engineer, to voice an opinion.

For 35 years I worked with the metric system and suddenly, in 1954, upon arrival in the United States, I had to change to the American system. I did. It took me about six months before I could think in inches and pounds. And now that I have settled down, make my living here and pay my taxes, I occasionally look back and compare both systems. This leads to only one conclusion: Working with the inches/pound system causes one heck of a lot of wasted time.

If I have to convert foot-pounds per minute to inch-ounces per second I grab for a table. Conversion from kilogram-meter per minute to gram-centimeter per second can be done mentally in about the same time as remembering in what book I can find the conversion table.

In some sciences the metric system is now being used, but for practical use of the obtained data in an applied science, somebody must be paid to translate the data into the inches/pound system. Another waste of time and money.

—Hugo J deBruin
Sycamore, Ill

Delaware Valley's Design Council

To the Editor:

It embarrasses me to be ignorant of the seminar being conducted by the Design and Drafting Council of Delaware Valley, mentioned in the March 30 issue (p 41). Where can I contact this group?

—Marvin O Young
Media, Penna

• Contact: Mr. Conrad, Chairman, c/o Catalytic Construction Co, 1528 Walnut St, Philadelphia 2.—Ed.

Engines, brakes, transmissions and mufflers . . .

. . . will likely be the big news when the small cars of the Big 3 make their appearance.

Already rumored are V-6 and pancake types, air-cooled engines, all-aluminum models, rear-mounting, transaxles, stainless and enameled mufflers, and disk brakes.

Of these, the best bets are aluminum engines (*PE*—Mar 16, p28), transaxles (transmission-differential-driving axle combinations), disk brakes, and at least one rear-mounted model.

The stainless muffler (*PE*—Nov 3 '58, p5) is being tested, but may not be ready in time. Likewise, aluminum brake drums with sprayed-metal tracks are receiving serious consideration; but no final decision to use them has been made. Air cooling, on the other hand, once considered a "sure thing," is not now being looked upon with too much favor, for the first models at least. It is not proving out as well in tests as it did on paper.

One thing is certain, though. The three cars can, between them, provide an excellent testing ground for a good many of the engineering innovations that no one has been willing to try in the full-size models.

Glass fibers that stand 5000 F . . .

. . . can be made commercially, says Dr. Alexander Silverman of U of Pittsburgh. Already, he's produced fibers which withstand baking at 2400 F for several days, and sees no reason why the techniques he's using cannot be extended to produce still-more-refractory fibers.

These are real glasses, made from minerals and high-melting oxides; but the production process is an unusual one that makes it possible to pass through transition points with great rapidity and thus retain high-temperature properties that would otherwise be lost. In progress reports to American Chemical Society meetings, he has pointed out that classical glass-melting methods can not attain the necessary melting temperatures. New techniques have, therefore, been required.

To produce fibers that can stand the 2400-F test mentioned above, a continuous processing system has been devised in which the raw materials, mixed with suitable binders to form a plastic mass, are extruded into rods, and dried and baked by convection currents on a continuous basis. Then, they move past high-temperature burners so that the lower end is melted rapidly and homogeneously; and, as it melts to glass, is blown into bulk fibers or drawn into monofilaments.

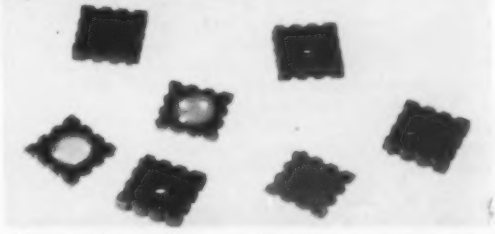
A gas-oxygen pilot plant of this type has been built and is demonstrating its ability to produce as much as 200 lb/day of fiber that is said to be longer, softer, and more durable than any others of its general type.

To produce fibers that will be serviceable to 5000 F, special gas and induction systems will be needed; but development of these is well underway.

Micromodule samples for engineering evaluation . . .

. . . are to be made available by RCA. These are the tiny amplifiers, discriminators, modulators, oscillators, pulse generators and mixers developed as part of the Signal Corps program to shrink electronic components to the point where it's possible to pack a million parts in a cubic foot (*PE*—Mar 30, p 19). Transistors, diodes, capacitors and resistors are all on ceramic wafers less than ¼ in. on a side (see photograph). As RCA proudly points out, these elements are already past the half-way mark in miniaturization. Parts density of assembled units is about 600,000/cu ft.

Developmental prices for the new units range from $46.60 for a 4.3-mc mixer to $247.30 for a dual-module binary divider. —ARG



Micromodule wafers, smaller than a penny, carry capacitor and resistor elements, transistors and crystals. They're grouped and stacked to make amplifiers, generators, and other units. Wafers here are made of Fotoceram, Corning's photosensitive ceramic, which can be "drilled" and shaped by photo-etching.

Introducing Allied's

IRILAC™ #1000

New Clear Protective Coating for All Metals . . . as safe and easy to handle as Water!

New method of protection incorporates corrosion inhibitors in a water-soluble polymer base. Dries to an extremely thin, tough, durable coating—clear in color. Does not chemically affect base metal or any post-treatments. Used as a protective treatment alone or to enhance value of post-treatments.

Allied's new Irilac #1000 is a concentrated solution of a water-soluble polymer with built-in complex corrosion inhibiting materials. It was developed to answer the needs of the metalworking industry for a non-conversion process that will provide corrosion resistance and resistance to fingerprinting and abrasion on base metals and electrochemically or chemically finished surfaces—without changing the appearance of the metallic surface.

There are no hazards involved—Irilac is non-fuming, non-toxic, and requires no special fire prevention measures.

THE PROCESS

Irilac #1000 is diluted with water to provide a simple one-pass working solution. It is then applied by dip, brush or spray and forms a coating that quickly *bonds* to the metal surface without reacting with the surface.

THE PROPERTIES

The resulting coating is clear, transparent, thin yet durable. It has excellent water-resistant properties, and can be rubbed, handled and subjected to rough treatment. The surface to which Irilac has been applied is not altered—in fact, the transparent coating brings full tone to colored surfaces and clarity to iridescent surfaces. The water-thin physical characteristic of the solution means that the coating provides protection in recessed areas that are difficult, if not impossible, to protect with other methods.

STEEL PANELS: bare (left) and coated with Irilac (right) after 8-hour salt spray.

ALUMINUM PANELS: bare (left) and coated with Irilac (right) after 168-hour salt spray.

WHERE IRILAC CAN BE USED

Irilac #1000 can be applied to *any* metal—wet or dry—treated or untreated. All metals can be processed in *one* operation in the same solution. It can be applied in conjunction with any process—over Iridite, anodized, phosphated surfaces, black oxide, etc. Surfaces treated with Irilac provide a good base for paint.

APPLICATION ADVANTAGES

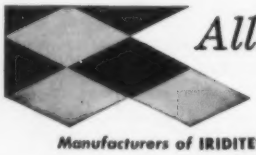
No other process or material available for the protection of metals offers all the application advantages found in new Irilac #1000:

1. It can be applied to *any* clean metal simply by dip, brush or spray. No special equipment is required.
2. Saves time—just apply and dry—no reaction time required.
3. No hazards involved—no exhaust or special fire protection equipment is required. Irilac is non-fuming and non-toxic.
4. Saves space. Presents no disposal problem. Low in first and final costs.

Because of its versatility and complete safety, Irilac has unlimited uses. For example, it will protect aluminum furniture, brass hardware and fixtures, steel parts of all types, zinc castings, etc. In fact, any base metal or plated surface, or those treated with electrolytic or chemical post-treatments, can be improved or enhanced with Irilac.

IRILAC #1000 MAY BE THE ANSWER TO YOUR PROTECTION PROBLEM

Our development staff will be glad to work with you to determine the significant benefits Irilac can offer you. Simply send us some parts and let us show you what Irilac can do. No obligation, of course.



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Manufacturers of **IRIDITE®, IRILAC™, ARP® Brighteners and Plating Chemicals**
West Coast Licensee: L. H. Butcher Co.

DEVELOPMENTS TO WATCH...

World-wide

A level-monitoring system for dry materials . . .

. . . has been developed by Siemens-Schuckertwerke, Erlangen, Germany, using standard components and featuring simplicity of design. The sensing device is an ordinary plumb bob suspended on a cord wound on a revolving drum. The drum is driven by a single-phase motor through a friction clutch and a reduction gear, so that the bob is raised and lowered at frequent, pre-set intervals. At the same time, a measuring potentiometer connected to the drum transmits level data (in the form of a measurable voltage) to the metering circuit. This includes a quotient meter, pen recorder, bridge circuit, and moving-coil meter.

Siemens says the system can be applied to handling almost any bulk material (abrasives, coal, grain) as long as the filling rate is not too rapid. The present system, specifically designed for bulk materials in bunker or silo storage, cannot handle a rate of rise much greater than 22 ft/hr, and bunker depth should be less than 40 ft.

Permanent magnets and the heat of the sun turn the rotor . . .

. . . of a "sun turbine" built in the USSR. As the Soviet engineers describe it, the device is designed to create mechanical energy by the reciprocal action of the magnetic field of a set of permanent magnets under the influence of sun heat.

To accomplish this end, turbine rotor blades are an alloy which loses its magnetic power rapidly when it is heated. Permanent magnets are mounted in pairs on the outer rim of the rotor and a lens for focusing sun heat is installed between each pair. As the force of a magnet acts on a rotor blade, the blade is pulled around toward it. As it reaches the magnet, though, heat focused by the lens causes it to lose its magnetism, and it slips by as the next blade is attracted. This way, the Russians say, "the blades move at an even speed," giving the rotor a smooth revolving motion so that the free end of its shaft can be used as a power takeoff.

Xerographic computer output . . .

. . . that prints at speeds to 5000 lines/min. (130 characters/line) has been developed by Rank Precision Industries, Ltd, London W6, England. It handles paper in rolls up to 26 in. wide, and produces two copies as it goes along.

The unit is designed to accept data in binary-coded form, and displays it as alpha-numeric characters on a standard cathode-ray tube. This is synchronized with the form master so that the variable data and fixed form are correctly superimposed on the xerographic drum. Order codes control spacing, line-feed carriage return, horizontal and vertical tabulation, form selection and dynamic stops. It is also possible, says Rank, to reject specific blocks of data as desired so that, for instance, a customer's number may be printed on the invoice copy, but not on the original.

Rank plans to market the printer to and through computer manufacturers, expects the first production models to be in use by the fall of 1960. —ARG

Xerographic printer is key unit in new computer output system. Interchangeable plugboards control printing layout.

NEW WOUND FIELD MOTORS / VERSATILE

Precision miniature wound field d.c. motors in five basic frame sizes (to 2¼" OD and to 1/10 hp) and in countless variations are now available from Globe Industries. You can design them into many military and other high quality products because they meet such an enormous variety of power and duty requirements. **Examples:**

Split-series units reverse rapidly and simply with a SPDT switch. Series units start with relatively high torque, low current drain. Shunt wound varieties offer means for low current control. Universal motors operate on a.c. or d.c. Globe-designed gear reducers, brakes and clutches can be built into the unit, and Globe can efficiently design and build the motor and accessories into a special motorized device.

If you'd like to look into miniature wound field motors of **any** description, or combine them with other components, ask the largest manufacturer of precision miniature motors first. Request technical Bulletin WF-1. GLOBE INDUSTRIES, INC., 1784 Stanley Avenue, Dayton 4, Ohio.

GLOBE INDUSTRIES, INC. GLOBE

Weapons reliability . . .

has come under Congressional fire. The House Appropriations Committee made a full-scale study of reliability efforts in ballistic missile projects and were unhappy with what they found.

The major conclusions of the committee: industry has not produced sufficiently durable and reliable components; there is inadequate testing of components in advance of assembly; and military inspectors and inspection techniques have not kept pace with the advancing complexities of modern weapons. Going further, the Congressional group proposed that henceforth reliability requirements be written into military specifications.

Where this is not practical, the committee wants contractors to be required to "adopt and maintain definite programs of training, indoctrination, workmanship review, and inspection in support of reliability achievement."

The legislators slapped at the Pentagon, too. They want officials to place more emphasis on "simultaneous environmental testing and simulated flight testing" of components.

Space Maps . . .

to chart the radiation belts that have been discovered in space are being developed.

Early satellites and high altitude rockets have confirmed the fact that radiation exists in space. And, the Pentagon's nuclear explosions last summer added more knowledge in the field.

Now, the scientists want to get a better picture of where the radiation is concentrated and how it moves about. A series of satellites will be sent up to collect this data. It is needed before man is sent into space, and scientists hope it will shed light on use of space for worldwide communications.

The nation's seven astronauts . . .

one of whom will be the first man in space, have been started on an intensive pre-orbital program to prepare for space flight some 2 to 3 years from now.

Initially, the spacemen will get first-hand knowledge of the construction of the space vehicle. Within the next year, build-up flights will be started, and seven men will actually be fired to sub-orbital heights, then ejected and parachuted back to earth. Jupiter missile boosters will be used for the tests, which will be conducted at Cape Canaveral, Florida.

It is still unofficial, but scientists at the National Academy of Sciences are exploring the possibility of using high mountain locations as conditioning areas for space flight. The Andes in South America they point out has 22,000-foot altitudes.

They claim the proposal has real merit. For one thing, personnel and equipment could be observed under conditions where it is absolutely necessary for space suits to be worn.

Granted, that true space conditions would not prevail, it is claimed to be an excellent test idea to augment laboratory simulated space environment.

Tomorrow's air traveler . . .

won't have to hustle down steps and make long weary treks to airplanes. That is why the airport designers revealed recently when the plans for Washington's new International Airport at Chantilly, Va., were unveiled.

Instead of boarding planes in the conventional manner, passengers will ride in mobile lounges that will service the new airport. Passengers will check in at ticket offices in the normal manner, then walk a few steps and board a mobile lounge—at the same level of the concourse. Just before flight time, the lounge will drive them out to their airplane, and the passengers will walk directly—and on the same level—into the plane.

The idea is to divorce the aircraft from the terminal. Overall it is supposed to cut costs and ease congestion. In addition, it should mollify foot-weary passengers that now sometimes walk nearly a ¼ of a mile to board planes.

The new mobile elevated lounge on stilts with wheels will measure about 15 by 60 feet, and will accommodate around 80 passengers. It will load from either end, similar to a ferry boat.

When the van reaches the plane, a pneumatic unit at one end projects and presses against the airplane and form a weatherproof sealed unit. The connecting unit can be telescoped, elevated or twisted to fit all planes. The van can be raised or lowered to compensate for the 5-ft difference in doorway heights of aircraft.

Piping pictures with fibers

Research in fiber optics, the new science that takes advantage of the optical properties of glass and other transparent materials in fiber rather than solid form (*PE—May 5 '58, p 6*), has progressed to the point at which image-transmitting assemblies can be produced,

Reporting to the recent Optical Society meeting, researchers of American Optical, Mosaic Fabrications, and the University of Rochester told how bundles of ultrafine glass fibers (down to 5 microns) make it possible not only to "pipe" light, but also to transmit data and reproduce images.

To create such effects, though, special fibers are needed. The ones used in this study consist of a glass core with a relatively high refractive index (to 1.75), surrounded by a sheath of lower index (about 1.52).

As representatives of the three groups pointed out, the fiber assemblies have technical limitations as well as the obvious advantage of flexibility. In most respects their optical properties can be characterized like those of solid glass; and their light transmission is high and their resolution "commensurate with the size of the individual fibers." But they are limited by the fact that their working distance is zero and they have no azimuthal or phase memory.

New way to trace shock

A simple, reproducible method for measuring transient elastic waves in metals is claimed by the Army Engineer R & D Lab at Ft Belvoir, Va., and lab engineers expect it to pave the way for new design criteria for shock-resistant equipment.

The system incorporates a strain gage, amplifier, and oscilloscope; and a Polaroid camera is used for recording.

The strain gage is attached to one end of a test bar, down which a shock wave is transmitted. The gage picks up the wave signal, transmits it to the amplifier, and this, in turn, transmits it to the oscilloscope. As the pip of light thus generated travels across the face of the oscilloscope, it is photographed by the pre-set camera. That's all there is to it, but the Engineers say that, with a 4-microsecond sweep, it is possible to obtain a detailed curve that will indicate speed of propagation of the shock wave, maximum strain, and duration of strain.

test equipment briefs...

An instrument rental and calibration service that will make available more than 13,000 instruments, ranging from voltmeters and microscopes to oscilloscopes and leak-detectors, is inaugurated by GE. An outgrowth of GE's own intracompany instrument service, the program will make equipment available through both service shops and apparatus-sales offices. As an example of charges, GE cites a deluxe oscilloscope which sells for $1500, can be rented for less than $75 a month, including maintenance.

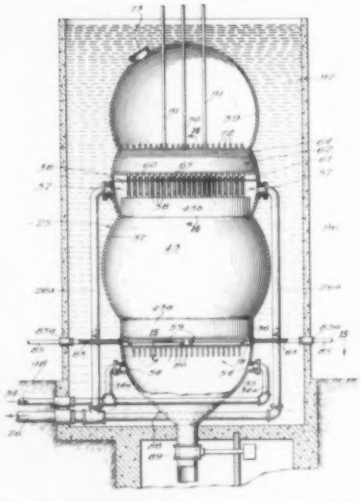
Brighter flashes for better high-speed motion pictures are promised by a new, more powerful and longer lasting FloodFlash lamp being introduced by Sylvania. Designed expressly for industrial and scientific work, the lamp is said to be capable of exposing 37 ft of motion picture film at 1000 frames/sec. Flash duration is 1.75 sec. List price: $2.35.

Single-shot, current-sensitive switch for circuit-testing is said to stand temperatures as high as 1000 F for 30 min., 750 F on a continuous basis. Called the Pyristor, it's the second in a line of specialty switches being developed by Thermocal Inc, Santa Monica, Calif. First to be announced was a temperature-sensitive Thyrastat; others are on the way. The Pyristor is a 2-amp unit, to be made in both normally open and normally closed types. —ARG

Benchmarks for a technological revolution

"The present invention relates to the subject of nuclear fission and more particularly to a plant wherein the heat generated as a result of the fission process can be removed at a rapid rate and preferably in such a manner that it can be utilized for the production of power."

So reads one of the history-making patents granted to Enrico Fermi and his coworkers, and just released after more than 13 years. Despite their age, these wartime patents still contain a surprising amount of useful information, plus fascinating diagrams like the one pictured here. Merely on this account, they're worth their purchase price: 25¢ each from the Patent Office. Among those now released are Numbers 2,206,634 (Nuclear Chain Reacting Systems); 2,708,656 (Neutronic Reactor); and 2,837,477 (Chain Reacting System).



Power reactor might look like this, Fermi predicted. The diagram is from one of his original patents.

DURABILITY AND ECONOMY are outstanding characteristics of these timing sprockets for automotive crankshafts. These sintered metal parts are the result of close cooperation between Moraine Products and the customer. They also represent a concrete demonstration of Moraine Products' ability to produce—economically and in quantity—rugged parts that stand up under strenuous operating conditions.

Parts shown ¾ actual size

Vital parts for Industrial Progress

Moraine Products
Division of General Motors, Dayton, Ohio

High alloys for higher temperatures

High alloys of columbium, chromium and molybdenum offer the best chance for development of materials serviceable at 2000 F or above, Battelle metallurgists believe. Says H. R. Ogden, Battelle consultant:

"Cobalt, nickel, and iron alloys have reached their peaks, and not much improvement can be expected from them." But he believes the three newer metals do look promising—particularly in combination with alloying elements like titanium and vanadium. One test showed, for example, that adding 10% Ti to Cb increased short-time stress rupture strength at 2000 F from 15,000 to 17,000 psi. Strangely, this alloy does not perform as well in long-term tests at lower temperature (1800 F) as does the unalloyed metal.

Columbium-vanadium alloys have also shown up well in preliminary tests at the 2000 F range; and they have excellent strength at room temperature (in the 80,000-psi range).

Much more work must be done, though, Ogden says, before the full potentialities of these alloys are known.

Rubber plus fuel: Watch hidden damage

Aromatic fuels may affect low-temperature flexibility of elastomers, even though the materials seem compatible at room temperature, Thiokol Corp warns. Several elastomers which have excellent volume-swell resistance during immersion in aromatic fuels show a marked decrease in low-temperature flexibility in subsequent tests. The reason: Apparently the aromatic fuel components leach out the plasticizers which normally contribute to low-temperature flexibility.

Best performance in these low-temperature tests, Thiokol proudly notes, was obtained with samples of its own polysulfide rubbers, one of which actually increased in low-temperature flexibility after 48-hr immersion in commercial fuels and a 48-hr drying period (24 hr at room temperature and 24 hr at 158 F). The nitrile rubbers, on the other hand, generally noted for their volume-swell resistance, showed up very poorly, the poorest performance being racked up by those samples with the highest nitrile content.

Triple play for new plastics

Are three plastics better than one or two? It's beginning to look that way when new fibers, films, fluids and finishes are needed. Plastics researchers have by no means exhausted the possibilities for improving these materials by combining two different resins; but several laboratories are beginning to look to three- or even four-component systems for additional improvements. Monsanto researchers point out, for example, that by adjusting the styrene, methylstyrene and acrylonitrile content of a three-component system, it's possible to obtain a whole family of resins, ranging from clear to opaque, and differing considerably in physical and mechanical properties. Several companies already have three-element (terpolymer) compounds on the market, among them Borden Chemical Co (floor finishes) and DuPont (wire enamels); but many others are working on them, and much more will be said about them in the months to come.

briefs . . .

Vanadium foil ½ mil thick has been produced by American Silver; and, with equipment now being installed, the company hopes to turn out 0.0003 in. vanadium, and columbium too. These foils are not yet stock items—but they can and will be produced to order. (For information on both metals and how such foils might be used, see *PE*—Mar 17 '58, p 66.)

Transparent fluorocarbon film said to combine outstanding weather and chemical resistance with good electrical, thermal, and mechanical properties, is now available in developmental quantities. This is DuPont's *Type R*, first announced about a year ago. DuPont is recommending it for electrical applications (it has a room-temperature dielectric constant of 7.5 at 60 cycles, stands temperatures from −100 to 250 F), and as a surfacing for laminates. The company notes that it can be vacuum-metallized and thermoformed. Initial price is $5/lb in thicknesses from 1 to 4 mils. Area coverage factor is 140 sq ft/lb; 1 mil thick.

For service at 600 F, Wright Air Development Center reports that a new aluminum alloy, with copper, manganese, and small amounts of vanadium and zirconium, is considerably superior to standard materials. After 100 hr at this temperature, strength tests show it to be twice as strong as 2024-T4 (20,000 psi as compared to 10,000), to have far less elongation (25% as compared to 65%). It also seems unusually resistant to stress-corrosion cracking. Information on the new alloy is contained in a 27-page report, PB 151 235, obtainable from Office of Technical Services, Washington 25, DC.

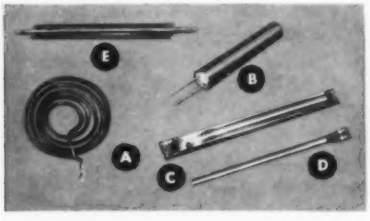
Another new nylon resin specifically designed for extrusion is expected to permit rapid, lower-cost production of shapes and profiles which previously had to be injection molded or machined. This one, from Spencer Chemical Co, is said to have machine handling characteristics "similar to polyethylene." It's a high-melt-viscosity, high-molecular-weight resin made by a new polymerization method. Like the extrusion resin unveiled last month (*PE—Feb 16, p 19*), Spencer's is of the nylon 6 type. The company says it has a tensile strength of 12,300 psi at 0.3% moisture content, and a heat-distortion point of 367 F at 66 psi. —ARG

Surface Heating Guide

How to choose electric heaters of the right type and size for your design

Here is condensed information to help you get the most economical electric heater for your surface heating design problem.

Two factors generally determine which type heater should be used for any particular surface-heating application. They are: the physical characteristics of your product, and the surface temperature required.



General Electric *tubular heaters* (a) can be formed to unusual shapes and may be "cast in metal" as part of your product during manufacture. They may also be located in grooves, inserted into drilled holes, immersed in liquids, wrapped tightly around the surface or spaced away.

G-E *cartridge heaters* (b) are ideal for "spot" heating of small areas. Short and compact, they can be easily inserted into drilled holes within the machine or surface.

For flat metallic surfaces, such as hot plates, platens and dies, *strip heaters* (c) may be clamped on or spaced away. General Electric *insertion heaters* (d) are ideal for heating hollow bolts for high-pressure steam-shell joints to prevent steam leakage.

For warming tables, and preheating plates, G-E *vane heaters* (e) may be clamped on or spaced away.

To figure the amount of heat required for your application:

1. Find the volume in cubic inches of the material in process.
2. Figure needed temperature rise in degrees F (subtract initial temperature of material from desired final temperature).
3. Find heat absorbed by material (Table 1 applies to all materials except those listed in Table 2). Values from Table 2 should be added or subtracted from values in Table 1 to correct it.
4. Determine the total surface area of the platen.
5. Using this area and the desired final temperature, check Table 3 to get heat losses of platen.
6. Add kilowatts computed in Step 3 to those computed in Step 5. You now know how much heat is required.

For complete information on sizes and ratings of General Electric heaters, send coupon below.

DELIVERY TODAY: Popular sizes of General Electric heaters are available today from General Electric stocks near your plant.

SPECIAL SAMPLES: Your General Electric sales engineer can advise you on special heating problems. If special heaters are required, he will provide samples.

PROMPT SHIPMENT: General Electric's new Industrial Heating plant at Shelbyville, Indiana, is now geared to give excellent shipping dates on heaters for your production needs. Just call your nearest General Electric Apparatus Sales Office and tell us your requirements. General Electric Company, Schenectady 5, New York.

TABLE 1—HEAT ABSORPTION IN KILOWATTS OF MATERIAL IN PROCESS

Volume of Material in Process (cu. in.)	Temperature Rise in °F					
	50	100	150	200	250	300
1	.006	.012	.018	.024	.030	.036
5	.030	.060	.090	.120	.150	.180
25	.090	.180	.270	.360	.450	.540
100	.360	.720	1.08	1.44	1.80	2.16
500	1.80	3.60	5.40	7.20	9.00	10.8
1000	3.60	7.20	10.8	14.4	18.0	21.6

This table is based on a ten minute working cycle. If working cycle is other than 10 minutes use following formula to correct values: 10 divided by the number of minutes in the cycle times the kilowatts given above equals the kilowatts at the new cycle. Table 1 will apply for all materials except for those listed in Table 2. Apply correction factor if needed.

TABLE 2 CORRECTION FACTOR

Material in Process	Subtract or Add % as indicated to figure in Table 3
Aluminum	−30%
Dry Wood or Paper	−50%
Wet Wood or Paper	+20%
Glass	−40%
Rubber	−30%

TABLE 3*—PLATEN HEAT LOSSES IN KILOWATTS

Surface area of metal platens in sq. inches	Final temperature in degrees F of metal platens			
	100	200	300	400
100	.024	.080	.160	.280
250	.060	.200	.400	.700
500	.120	.400	.800	1.40
1000	.240	.800	1.60	2.80
2000	.480	1.60	3.20	5.60
3000	.720	2.40	4.80	8.40

***This table based on platens being completely uninsulated.**

GENERAL ELECTRIC

Section E723-12, General Electric Co.
Schenectady 5, New York

Please send GEA-6146, Surface Heating Handy Selector Guide and GEC-1005, Catalog of G-E Heaters and Devices.

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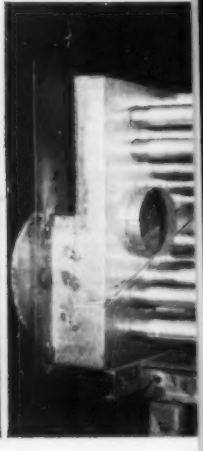
New steels are born at Armco

3 Ways to give plus strength

1. Armco ZINCGRIP Steel Tubing
2. Armco ALUMINIZED STEEL Tubing Type 1
3. Armco ALUMINIZED STEEL Tubing Type 2

These three grades of Armco's special coated steel tubing add low-cost protection against corrosion to all the design advantages of welded steel tubing. The reason: they are made of steel with mill-applied hot-dip coatings of zinc or aluminum. You can design tubular parts with built-in corrosion resistance that eliminates the necessity of painting, plating or other costly finishing operations.

Conveyor rolls are one of the many diversified applications where Armco ZINCGRIP Steel Tubing is giving excellent service. Many conveyor manufacturers have made ZINCGRIP Tubing their standard material because of its over-all economy and durability in both intermittent and continuous operations.



Armco ZINCGRIP Steel Tubing provides the strength and rigidity for gale-resistant microwave and TV towers hundreds of feet high. The adherent zinc coating doesn't flake or peel when cross braces are severely formed . . . assures over-all protection against rust.

your products low-cost durability and rigidity of steel tubing

For *your* products you can select the grade that meets your specific requirements with the best combination of cost and performance.

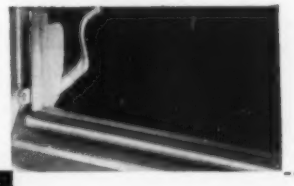
Armco ZINCGRIP® Steel Tubing—Welded steel tubing with a full-weight hot-dip zinc coating. It has many times the corrosion resistance of tubing with a light electro-galvanized coating. It can be severely formed in fabrication without flaking or peeling the special zinc coating. Available in rounds, squares, rectangles and special shapes.

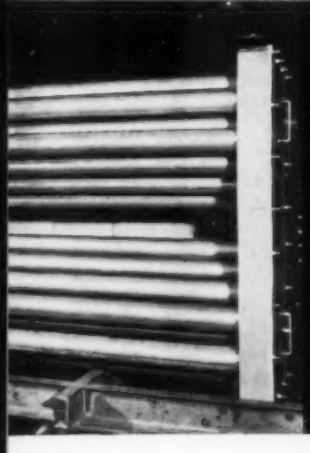
Armco ALUMINIZED STEEL Type 1 Tubing—A tightly adherent hot-dip aluminum coating provides resistance to a combination of heat and corrosion. The coating won't discolor when heated as high as 900 F and resists destructive scaling at temperatures up to about 1250 F. Available in rounds, squares, rectangles and special shapes.

Armco ALUMINIZED STEEL Type 2 Tubing—Welded steel tubing with a hot-dip aluminum coating that has especially good resistance to atmospheric corrosion. 18-year exposure tests in an industrial atmosphere show that the aluminum coating lasts at least twice as long as other protective coatings in its price class. Available in rounds only.

In the products *you* make or use, consider the design and production advantages offered by durable and economical Armco ZINCGRIP Steel or ALUMINIZED STEEL Tubing. For complete information on available sizes, shapes, properties and fabrication, just fill out and mail the coupon.

Torque tubes in jalousie and awning-type projected windows illustrate a practical application for Type 2 ALUMINIZED STEEL Tubing. Armco's aluminum-coated tubing provides rigidity, torsional strength, and low-cost resistance to weathering.





Heat exchanger tubes are an application for Armco ALUMINIZED STEEL Type 1 Tubing. Its resistance to a combination of heat and corrosion in this kind of exposure means longer and more satisfactory service at low cost. This extra-durable tubing is used in a variety of shapes for industrial, commercial and domestic gas heaters.

ARMCO STEEL CORPORATION
1889 Curtis Street, Middletown, Ohio

Send us additional information on:

- ☐ Armco ZINCGRIP Steel Tubing
- ☐ Armco ALUMINIZED STEEL Type 1 Tubing
- ☐ Armco ALUMINIZED STEEL Type 2 Tubing

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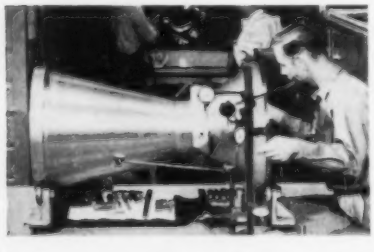
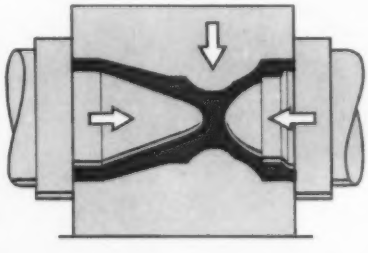
A BETTER NOZZLE MEANS A BETTER MISSILE

Nozzles for guided missiles are an important factor in performance and, of course, in cost. In the end result during their short-span service, they must produce proper thrust without disintegrating. In early production, despite their simple symmetrical shapes, they posed many knotty problems. Special alloys, thin sections, and close tolerances spelled trouble. So did their expendability, as always making costs a concern.

Today, after many years' production, we have delivered a staggering number of these problem pieces. The secret of our success has been our own unique Cameron forging processes which have extended the scope of ferrous forgings far beyond traditional restrictions in shape, size and quality. Elimination of welds along with better grain structure, internal as well as external curvatures, and considerable machining economy have made these forgings increasingly popular.





Our forgings are available as forged, rough machined, or finished machined, ready to save money in any phase of your operations. If you have a forging problem in components ranging from a few pounds to 8000 pounds, especially something for extreme service (high stress, high temperatures, etc.) we may have the answer. Special alloys are no problem because we produce our own steel with the most modern controls and tests from melt shop to delivery dock. Just call, write, or come by . . .

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THE CASE OF THE CRAZY GREEK

Back in 1946, a Greek-American in Athens applied for American and Greek patents on a synchrotron. He was an electrical engineering graduate of the Athens Technical University, born in Boston but brought up in Greece. He had always been fond of nuclear physics, but never had time to study it until the German occupation. In 1948 he wrote the University of California about his ideas.

Scientists there wrote the 32-year-old engineer that he'd made mistakes and had better go read some more books. So he did—and came up with the "strong-focusing" principle that involves shooting a narrow beam of atomic particles at light speed without magnets. Another year of proving the principle nights by mathematics—it was of course an intuitive breakthrough—and he applied for another patent and wrote another letter.

He got another brush-off, partly because of language and symbol differences, and the suggestion that he read a specific math book. It was two years before he could get the book, but promptly found his mathematical proof was correct. So he headed for the United States to prove his point. His first day in New York, however, he found a copy of the *Physical Review* for December, 1952, in the library—and found his principle "discovered" by and credited to three scientists at Brookhaven.

He went to see them and explained his 4-year priority, got them to check with the University of California for proof. Shortly, he had a $10,000 AEC grant, an appointment for research at Brookhaven, and public acknowledgment from the scientific trio that he was first. Savings from his idea are estimated at $70 million per machine. By 1956, he had his patent and got an appointment for an AEC experimental program at—you guessed it—the University of California. Project Argus—creation of an artificial radiation belt with an atomic blast in space—was his idea. Right now he is heading a group of physicists working on a thermonuclear power plant, has been called fondly "the crazy Greek" in newspaper headlines.

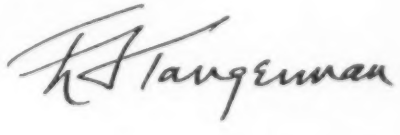
Why did Nicholas C. Christofilos have such a long and soul-beating fight for his ideas? Because there are so many cranks with notions, so many "crazy Greeks," so many men who aren't properly equipped with the degrees and standing to be "members of the fraternity."

There was the auto mechanic who finally taught scientists how to grind the 200-in. mirror for Mount Palomar. American ideas on the tank and the rocket *had* to be sold abroad. There have been countless others—shop men, mechanics, postal clerks—who have broken through the protective wall of wrong, but exclusive, knowledge with a new idea.

It isn't only in science and engineering that this occurs. There was Heinrich Schliemann and his discovery of the site of Troy by hunting it where the *Iliad* placed it. There have been the recent proofs that Bible stories are based on historical fact. (For proof, see "The Bible as History," by Werner Keller—Morrow.) You know of others.

In the case of the "crazy Greek," scientists admitted their error, a salutary example. If we who have le. ned too much about failures in our field can listen—even if eventually—to a layman without our knowledge or inhibitions, but with a new idea, there is still hope.

How long has it been since you arbitrarily closed the door on a new idea?



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Industry Raises Ante in New Product Search

Survey by McGraw-Hill Dept. of Economics Foresees Increased R & D Through 1962: New Products Stimulate Plant, Equipment, Investment, Industrial Capacity

NEW YORK—American industry will allocate $9.1 billion to a planned attempt to develop new products and basic scientific knowledge this year. Such expenditures are in 11% increase over last year's $8.2 billion. And industry further plans to increase R & D in upcoming years. The research tab in 1962 will probably run $10.6 billion. These are salient findings in a survey just completed by the McGraw-Hill Dept of Economics.

The survey also indicated companies are planning to add $523 worth of new facilities for pursuing their R & D goals. Especially heavy building programs are scheduled in the transportation-equipment industry where about a quarter of all spending on plant and equipment will emerge as research labs.

The survey reaffirms the increasing emphasis business firms are placing on R & D. In 1953, spending for such purposes amounted to $3.7 billion; in 1956, to $6.5 billion. Hence, over the ten-year period, 1953-63, industrial R & D will about treble.

During the interval between 1953 and the present, the aircraft industry has accounted for a substantial and increasing portion of all research. In 1953, aircraft plants performed roughly ⅛ of industrial R & D, this year they will perform over ⅓—a trend that arises out of government's interest in military aircraft and missile development. The government pays for about ½ of all industrial R & D and well over ¾ of the work by the aircraft industry. The electrical industry has consistently accounted for about ⅛ of all R & D and in recent years the government has footed about ¾ of this bill. But it is significant that the trend toward more research is evident in industries less dependent on government work as the chart indicates.

Emphasis on research and product development is a crucial force behind industry's plans to expand that are evident in the survey. (Industry's experience is that 40% of R & D pays off in marketable products within three years; 90% within five years.) These plans portend a steadily growing economy over the next five years.

Companies Add R & D Facilities
(millions of dollars)

Steel	$24
Nonferrous metals	9
Machinery	60
Electrical Machinery	27
Autos	50
Transportation Eq.	110
Other Metalworking	50
Chemicals	111
Paper	25
Rubber	3
Stone, Clay & Glass	12
Petroleum Refining	7
Food & Beverages	20
Textiles	8
Miscellaneous Mfg.	7
ALL MANUFACTURING	523

Manufacturing firms, the survey indicates, presently expect to spend $10.5 billion on new plant equipment each year between now and 1962. Generally, plans for advance years are revised upward as the time approaches. This is a level of investment 7% over last year's $9.8 billion. Much of this year's capital investment program —about 65%—will be required to replace and modernize plant and equipment that have become obsolete; the remaining 35% will expand production facilities. The same ratio of expansion to modernization is expected between 1960-62.

The productive capacity of American industry is expected to grow another 4% this year and 11% by 1962 if reported investment plans materialize. Industrial capacity, the survey notes, has grown by about 48% since 1951.

Manufacturers foresee rising sales this year and throughout the 1959-62 interval. As a whole, manufacturing industries expect physical volume of sales to increase 7% this year and another 14% by '62. Especially sharp gains are expected this year in autos, trucks & parts (19%), iron & steel (31%), nonferrous metals (10%), stone, clay & glass (10%), machinery (9%), and electrical machinery (8%). Over the longer view to 1962 sharp gains are foreseen for autos, trucks & parts (30%), electrical machinery (29%), nonferrous metals (26%), iron and steel (27%), and stone, clay & glass (17%).

US Firm To Increase R & D Support

	(millions of dollars)			Planned	
	1958	1959	% Change 58–59	1962	% Change 59–62
Primary Metals	$117.0	$133.4	14	$154.7	16
Fabricated Metals	199.1	215.0	8	253.7	18
Machinery	605.4	653.8	8	778.0	19
Electrical Machinery	1435.6	1636.6	14	2176.7	13
Aircraft	3037.7	3341.5	10	3675.7	10
Prof and Sci Instruments	324.5	353.7	9	435.1	23
Chemicals	607.2	637.6	5	752.4	18
Petroleum Products	259.2	295.5	14	328.0	11
Rubber Products	85.9	94.5	10	111.5	18
Stone, Clay & Glass	70.8	78.6	11	91.2	16
Paper Products	52.8	57.0	8	71.3	25
Food & Kindred	94.4	100.1	6	119.1	19
Textiles & Apparel	33.3	33.3	0	37.0	11
Other Manufacturing*	894.6	1019.8	14	1193.2	17
ALL MANUFACTURING	7817.5	8650.4	11	10177.6	18
Non-manufacturing	363.3	399.6	10	431.6	8
ALL INDUSTRY	8180.8	9050.0	11	10609.2	17

* Includes autos, tobacco, lumber & wood products, furniture, printing and publishing, transportation equipment other than aircraft and autos, and miscellaneous.

A Look at Newest US Missile Test Center

Product Engineering's Washington editor, Seth Payne, visits Wallops Island, Va, where all phases of NASA's space rocket testing will be conducted.

WASHINGTON — A small, little-known island hugging the Atlantic Coast just north of Norfolk, Va, will soon be one of the busiest missile-launching sites in the US. Wallops Island—the National Aeronautics and Space Administration's own Cape Canaveral—is already in business, firing at the rate of 100 rockets a year into space. Within a couple years it will be firing almost one a day, comparable to Cape Canaveral's 96 shoots last year.

Wallops Island won't be firing the largest military and space missiles—the ICBMs and deep space probes to the Moon, Venus, and Mars. But it will be handling just about every other phase of the rocket and space business. The NASA will launch from Wallops all types of high-altitude rockets, test missile components, and put communications and weather satellites into orbit.

To handle this, Wallops Island will have a complex of blockhouses and buildings, tracking facilities and launching pads, downrange tracking facilities comparable to a junior-size Cape Canaveral and the other new launching site at Vandenberg Air Force Base, near San Diego, Calif.

Most Wallops Island shoots are fired out over the Atlantic and tracked from the base. By mid-1960 NASA will have tracking ships stationed at sea, and a permanent land-based station in Bermuda.

The island is relatively close to Washington, NASA's new headquarters to be built nearby at Beltsville, Md, the Pentagon, and big defense contractors along the East Coast.

To reach Wallops Island it is necessary to drive some 180 miles south from Washington or Baltimore, or fly to the Norfolk area, ferry across Chesapeake Bay, then drive north up the eastern shore to the island. It is a 3 to 4-hr trip either way, but considerably less than a junket to Canaveral.

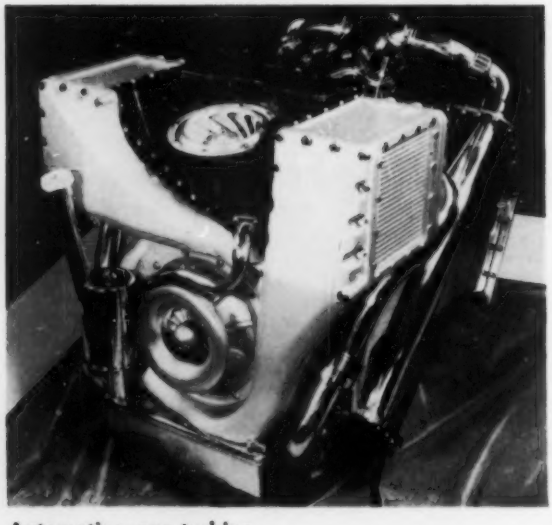
Before Wallops Island was taken over by the NASA, it had less than 100 scientists, engineers and technicians. Today, its staff has almost tripled, and is still growing. In addition, there is a continuous flow of visiting delegations of scientists and engineers both from government and industry trekking to the island to monitor shoots.

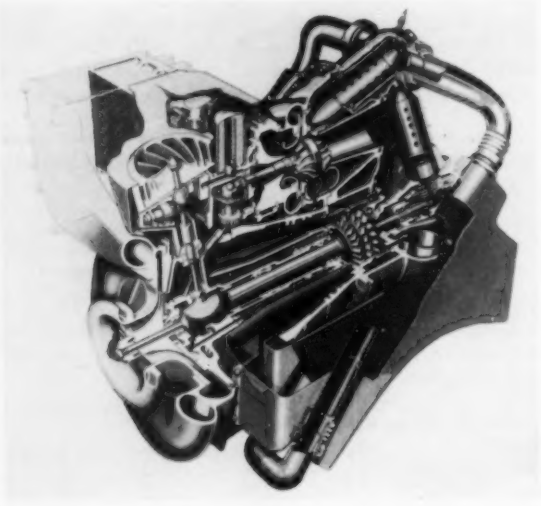
Security-wise, Wallops Island is still relatively accessible, compared say, to Cape Canaveral. But, as it grows, the guessing is that it too will become enshrouded with tight security rules.

WHAT THEY'RE DOING

NASA scientists here are already hip-deep in many space problems. Among them:

Rockets have been fired up 500 miles to collect meteorological and other space data. Scale models of the Air Force glide-boost bomber (Project Dynasoar) are being tested. Heat transfer tests are being made on the





Automotive gas turbine . . .
by Ford Motor Co has an output of 300 hp. Ford says the engine measures 38 in. long, 29 in. wide and 28 in. high, weighs 650 lb, one-fourth as much as a truck diesel engine of the same hp. Fuel economy is said to compare favorably with a diesel and is better than a conventional gasoline engine under most conditions. Cutaway of the supercharged engine shows the low pressure compressor and turbine drive assembly in lower center; the intercooler fan, upper left foreground; the intercooler, extreme upper left; high-pressure compressor, turbine and accessory drive, upper center; primary and secondary combustion chambers, upper right; exhaust heat exchanger, lower right; and power output turbine, right center. Ford says the engine gets max fuel economy in a range of 25 to 100% of power. The low speed compressor turns at 46,500 rpm; the high speed compressor at 91,500. The power turbine turns the drive shaft at 4,600 rpm at full power. Primary and reheat combustion chambers operate at 1,700 F. Exhaust gas temp is 740 F. Ford expects to be testing the engine in vehicles this year.

nose cone of the Navy's submarine-launched, Polaris missile. Various phases of Project Mercury—slated to put a man into space—are underway at Wallops Island. Companies doing missile work for the military use Wallops Island test facilities, as they do at Cape Canaveral. Last fall when the government exploded its nuclear blasts in outer space, rockets fired from Wallops Island collected data.

The program designed to collect meteorological data is being stepped up; starting this September, for example, one to two rockets a week will be fired for the next several years.

Within the next couple of years, NASA's communication and weather satellites will be propelled into orbit by the low cost, solid-fueled Scout rockets that are now being developed.

Most of the preliminary work necessary for preparing an experiment for firing is done at the NASA's $100-million dollar Langley Aeronautical Laboratory, located some 70 miles south of Wallops at Langley, Va. Test vehicles are then trucked to Wallops Island and assembled for firing. Shops on the island can handle minor adjustments, but it relies on the Langley facilities if major changes are required for a shoot.

Up to now, the bulk of the firings at Wallops Island have been small vehicles and simple shapes, many with no instrumentation. It has racked up some impressive "firsts", however. Its staff claims to have fired the first five-stage rocket in 1956. The vehicle reached an altitude of 550-mi and speeds of over Mach 12, carrying a 30-lb payload.

Currently, experiments are being run at the island to determine the aerodynamics of the blast wave, resulting from a nuclear bomb burst, striking an aircraft or missile. The biggest shock tunnel in the world—80 ft long, 10 ft in dia—is in operation to conduct the tests over the next 2 to 3 years. The experiment has been given top priority, is largely classified. Knowledge gained from the tests will be used in anti-missile defense and in the manner in which nuclear bombs can be dropped offensively on an enemy.

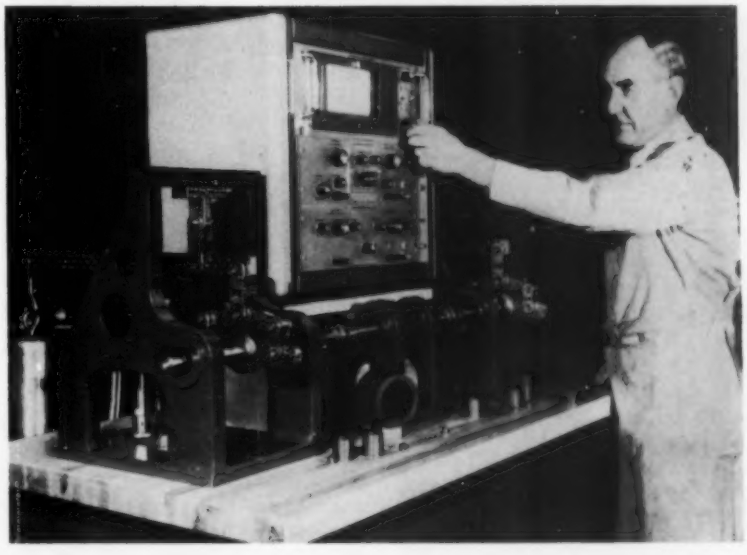
EXPANSION PLANS

This June 30th, the NASA will take over the 2400-acre Naval air station at Chincoteague, as part of the over-all Wallops Island complex. It is four miles from the island. Plans are to transfer all administration and support facilities from Wallops Island to the Cincoteague base, making a virtual firing pad out of the island itself.

In addition, NASA will buy an additional 350 acres on the mainland plus around 1200 acres of marshland in the area. There are some $10-million in facilities at Wallops Island now, and another $21-million has already been earmarked for expansion.

Here are projects planned or already underway:

- Within the next few weeks, work will start on two new firing pads plus support facilities capable of firing IRBM missiles. Cost: around $2.5-million.
- A special sounding rocket launching area will be built at an estimated cost of $1-million.
- A new 60-ft dish radar on a 90-ft tower will be built on the mainland just behind the island to track orbiting satellites. Cost of the radar will run around $2.5-million. Interim equipment is slated to be in operation this summer to bridge over until the permanent set is installed next year.
- A major tracking station for Bermuda is expected to be in service by the middle of next year. The facility will be capable of commanding and collecting data from rockets, satellites, and manned space capsules.
- One or two tracking ships are planned to operate between Wallops Island and Bermuda.
- Around $10-million will be spent for additional instrumentation.



Bearing Tester Speeds Development of New Oilless Bearing

PHILADELPHIA—An unusual bearing testing machine was designed by the Arguto-Oilless Bearing Co for the development of its new Arguto-MP molded plastic oilless bearing (*PE—Mar 9, p 9*). The company says this tester considerably reduced the time normally required to determine the proper formulation, the method of blending and the fabrication techniques for the new bearing, as well as testing bearings under different combinations of speed and load.

Basically the machine (above) consists of a 1-in.-dia shaft driven by an electric motor through a variable-speed drive to give shaft speeds from 60 to 1000 ft per min. The bearing to be tested is pressed into a retaining ring in the bearing support arm, which is part of a parallelogram mounted on hardened knife edges. The bearing is loaded by a levered weight arm to loads from 0 to 1000 lb.

Friction force is measured by strain gages and is recorded directly as co-

efficient of friction on a dual channel oscillograph. The bearing temperature is measured by a thermocouple buried in the bearing wall within 0.020 in. of the loaded side of the bearing surface. Shaft speed is indicated directly on a tachometer.

In the dual model machine, a chopper circuit feeds coefficient of friction and temperature figures through the same amplifier so that a simultaneous direct comparison can be made between the two bearings being tested.

In setting up the test program, Arguto established 15 basic ranges for accelerated test, results of which will appear in a forthcoming issue. A range consists of running the bearing testing machine at a constant speed and starting with an initial load that may vary from 5 to 50 lb, depending upon the range to be run. At the end of each two hour interval, the load is increased by standard increments until a final PV value in the neighborhood of 50,000 is reached. Bearing temperature and coefficient of friction are recorded during test.

Arguto says the new testing machine also proved useful in comparing the performance of other types of oilless and dry lubrication bearings. Besides testing oilless and dry lubrication bearing materials, the machine has been used in testing journal bearings with various types of drop feed lubrication, and can be used for testing rolling element and sliding bearings.

Design More Efficiency in Making of Sea-water

NEW ORLEANS—A new thermo-compression, seawater distilling machine that operates on a ratio of more than 300 lb of water to one lb of fuel as compared to the conventional 225-1 ratio is being manufactured by Mechanical Equipment, Inc here.

Advantages include elimination of scaling, which up to now represented 40% of the cost of making distilled water. Also, the time-consuming periodic cleaning required by conventional machines is no longer necessary. By operating at 100 degrees lower temperature than other machine, most of the corrosion is eliminated. All parts of the machine that come into contact with seawater are non-ferrous or plastic.

Production Explosive Forming on a Predictable Basis

AZUSA, CALIF—"There are three points to clarify on explosive forming," says Eric Henriksen of Aerojet-General's Explosive Ordance Division. "One, it has progressed out of the laboratory stage and is now being used for production fabrication. Two, we have developed methods of predicting and calculating what we can do with explosive forming. Three, cold metals do not behave like viscous fluids; they behave like cold metals under dynamic conditions."

The company's Explosive Ordance Division is reported to have already provided production cost estimates for consumer as well as military products.

At the fully instrumented Aerojet test facility in Azusa, special transducers, recorders and high-speed photography provide complete records of what has taken place during forming. In huge concrete water-filled tanks below ground-level, Aerojet engineers have shaped domes over 50 in. in dia, plus a variety of other shapes and sizes. Parts can be formed within 0.004 in. of the diameter of the single female die and tolerances can be held to less than 0.00005 in.

Henriksen states, "Most metals will show an increase in elongation when dynamically loaded. The rate of loading during explosive forming—500 to 2,000 fps—is high enough to take advantage of this increase. Comparing a static stress-strain curve with a dynamic curve shows that the fracture point is much higher under dynamic conditions. So are the yield point and the ultimate. With explosive forming, it is possible to work right up to the fracture point on the dynamic curve rather than stopping at ultimate strength on a static curve."

Henriksen has been devising tests and methods by which engineers can determine the limits to which explosive forming may be used in any given situation. Conventional strength-testing equipment is not adequate for this work, he says, because it can apply stress in only one direction and cannot therefore give valid data for the multi-directional force of explosive forming.

A preferable method is to run dynamic tests by performing the job on a greatly reduced scale, using a sheet of material that has been marked to permit accurate measurements of deformation. High-speed motion pictures, taken during the explosion against a graduated background, show progressive deformation as the force of the explosion is applied. Together with examination and measurement of the pre-marked samples after forming, the strain rate, deformation energy, radial displacement and increase or decrease in flange diameter can be determined.

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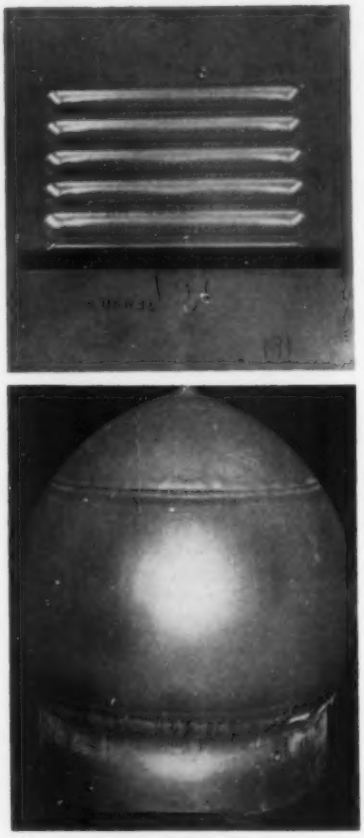


They're explosive formed . . . stainless beaded panel (top) for use in fabrication of aircraft component parts. Formed by Aerojet, it is one of several similar parts formed from a super-alloy material which previously had negligible formability. Below is an almost spherical head explosive-formed by Aerojet from an aluminum cylindrical weldment. Max dia is 27 in.

in; and the bigger the better) are tested to fracture and at several points of decreasing deformation. From these data, a curve can be plotted to show the maximum movement of metal that can be obtained under various known conditions. Says Henriksen, "Tests made here on very large pieces have fully confirmed the reliability and predictability of these results."

If the desired part cannot be formed as a "one-shot" operation, it must be removed and re-annealed between shots. However, Henriksen points out that the use of multiple charges and other "tricks of the trade" makes possible some extension of the limits indicated by the tests. These do not alter the validity of the plotted curve; they change the loading rate to reach a new point.

Energy requirements do not present much of a problem, Henriksen says, except that they do influence the construction of the tank in which forming is done. Explosives themselves are relatively cheap and scaling charges up or down is fairly simple. Also, utilization of the force of an explosion under water is quite high, because this would be the product of the size of the charge, the distance, and the ratio of the target to a sphere at target distance. In practice, added energy is derived from shock waves that miss the forming area and are reflected back from the walls of the tank.

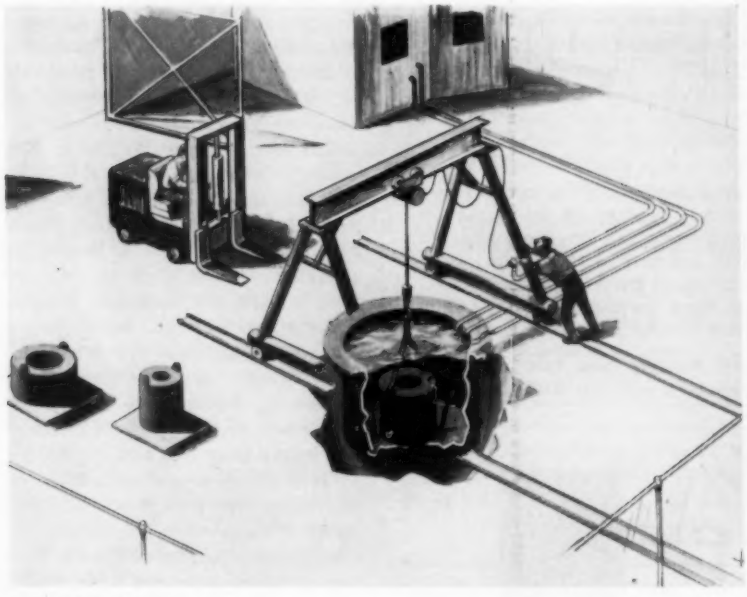
Ryan Uses Explosives on Hard-to-Form Metals

SAN DIEGO—Ryan Aeronautical Co, who has done extensive work—with the hard-to-handle metals for the aircraft industry, has just installed an explosive forming station, or "high-energy-rate forming", as they call it. Some of the metals they're presently working with using explosive forming are Inconel, Rene 41, Hastelloy, 321 and 17-7 stainless steel, titanium, and some of the new exotic metals.

In Ryan's new test set-up, several types of explosives will be tested, including dynamite, tetryl, PETN and cyclonite on hard metals ranging in thickness from 0.016 to 0.063 inch. The metals will be formed in spherical, conical, cylindrical, flat, corrugated, and blanking dies made of kirksite, steel, and plastic. Research is being done with a view towards establishing definite parameters which would be used with various metals. Once these have been established, production line rates can be obtained in forming parts.

Ryan claims it is forming in 15 min with explosive forming, a part that required 8 hours to form with a drop hammer. With explosive forming, metal moves into the die at speeds of 100-500 fps, compared to 1-5 fps using conventional methods.

The explosives used in high energy forming develop great power as well as speed. TNT generates 690,000 psi,



Explosion pit . . .
at Ryan Aeronautical Co shows how die holding metal to be formed is positioned.

design engineers

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page 32

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nitroglycerin, 1,200,000 psi; and 30% ammonia gel produces 490,000 psi. Using PETN, which is a blanket type of explosive somewhat resembling linoleum, a single blank has been formed into two different side-by-side shapes of different depths. Ryan also is making hemispheres, bell shapes, corrugations and deep draws.

Ryan says there isn't any agreement as to what does the actual forming. Some say that the shock wave does the work; others believe that a gas bubble is formed in the liquid which forces the metal into the die; and others think that the shock wave pushes the liquid ahead of it to form the metal. Also, no one is quite sure why there is an almost complete lack of spring-back and work-hardening. It is suspected that there is a reverberatory action from the blast which has a hammering effect on the metal.

US Recruiting Approach Puzzles Canadians

TORONTO—Job-hunting Canadian engineers are plainly perplexed by US industrial recruitment methods, according to a story in The Financial Post, a Canadian newspaper.

Recently, the paper says, a large American company, with a missile making plant in Eastern US, advertised flamboyantly in local newspapers its need for a wide range of engineers and technicians: salaries would range from $9,000 to $17,000. Despite the lavishness of these ads, the personnel recruiting office of the company was listed under a code name.

After that the plot thickened. Following a deluge of response to the ads, an officer of the company admitted that only a few engineers were needed, and that for the present, there'd be no hiring.

T. M. Medland, executive director of the Assoc of Professional Engineers of Ontario, had his own interpretation: "Many of us have noted this big advertising approach by US firms, even when the companies concerned were known to be laying off engineers."

"It could be a tax-free method of advertising the company" he suggested. Meanwhile, the roster of unemployed engineers in Canada continues to grow as the morale descends. Many have made plans to emigrate to the UK or to California.

Study Fatigue Properties of High-strength Steels

WASHINGTON—The National Bureau of Standards announces that experiments into the fatigue properties of high-strength steels have shown that retained austenite, in increasing amounts up to 10%, lowers fatigue strength. The tests, made in cooperation with the Univ of Maryland, also showed that fatigue stressing transforms retained austenite to untempered martensite, which probably accounts for the deleterious effect.

NBS expects the results should have practical applications in the choice of steels for critical parts, such as missile casings and aircraft structures, and in the processing of high-strength steels.

The study was made to learn how controlled variables—such as carbon content, tempering temperature, cooling method for hardening, and refrigeration—and dependent variables such as retained austenite and hardness are related to fatigue strength. Test specimens were made of four low-alloy steels whose carbon contents ranged from 0.44 to 1.06%.

Aluminum Forging Now After Civilian Market

ERIE, PENNA—Three hydraulic presses —one of them of 8000-ton capacity —form the nucleus of Kaiser's $5-million investment in aluminum forging facilities for the civilian market. Although the forging segment of this light-metal industry was hardest hit in the recent recession and has been slowest to recover (with present production still only ¼ of World War II peak capacity) Kaiser optimistically is out to capture a bigger share of an expanding market in non-aircraft applications. Its expanded capacity and know-how has made aluminum forgings more competitive with sand castings and die castings of the same metal and even challenge steel forgings. Aluminum forgings are offering these advantages:

- Better dimensional tolerances (±0.010 in. or better) saves machining costs.
- Finishing properties superior to diecastings. This cuts rejects later on when plating or anodizing; also offers anodized color that matches wrought aluminum.
- High strength competitive with that of low-carbon steel. Aluminum

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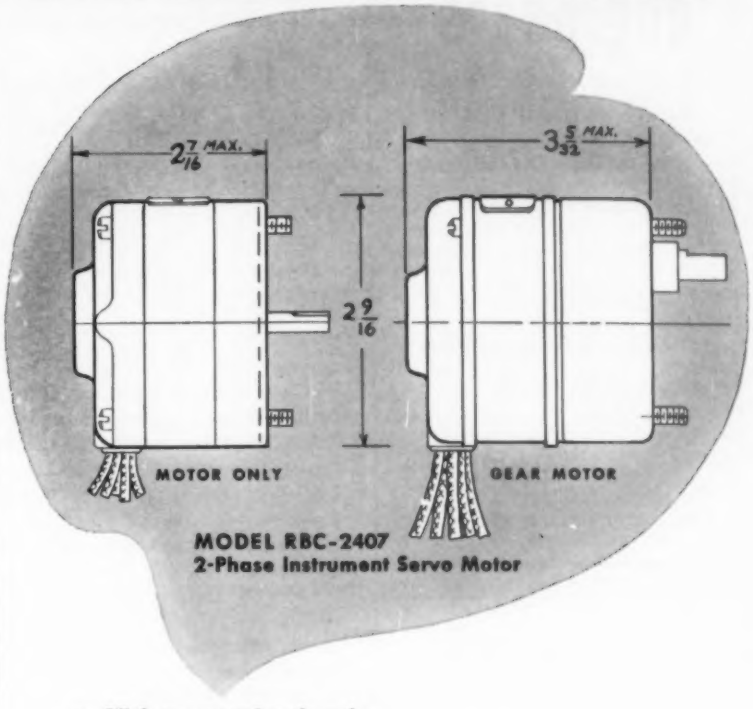

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US Firm Wins Patent Case in Japan Court

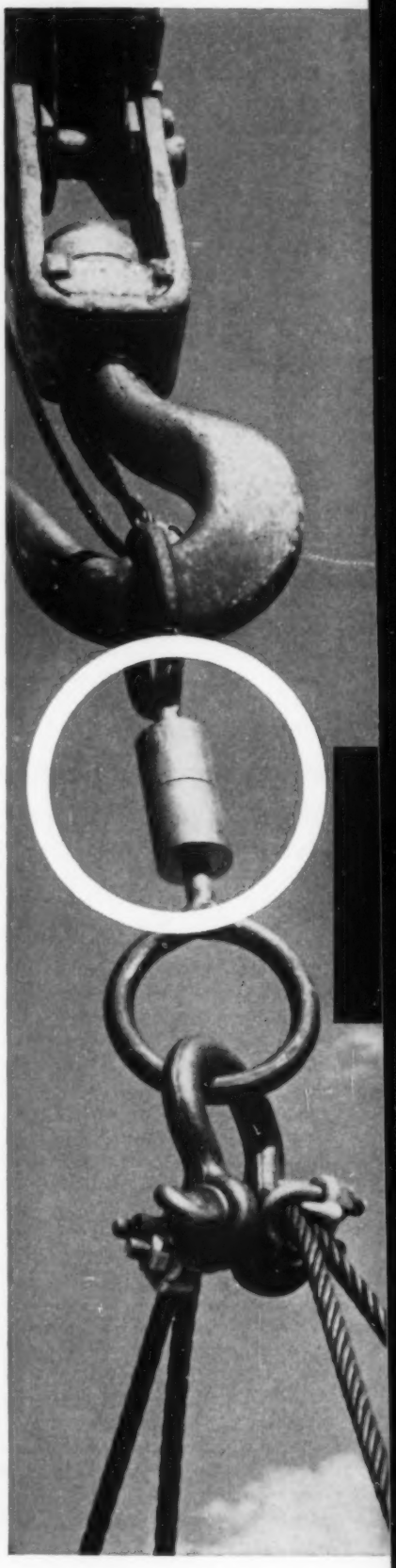
TOKYO—The Osaka District Court has ruled in favor of the two-year-old suit filed by Harper J. Ransburg, representative, Ransburg Company, Indianapolis, Ohio, in a patent infringement case against Oriental Infrared Ray Company.

Ransburg came to Japan in 1957 and asked the court to enjoin 8 major Japanese electrical firms and Oriental Infrared Ray Company to pay $3.3-million royalties for the use of his Japanese patent registered in December 1956. (For further information on Japanese design piracy problems, see 'Shame Show' Indicts Japanese Design Piracy, *PE, July 21, '58 p 20*).

Oriental Infrared Ray Company manufacturers and supplies electrostatic coating machines to most of the Japanese electrical firms. Oriental contested the suit on the grounds that Ransburg's sprayer idea was nothing extraordinary. The company asked to be allowed to continue making machines while the court was deliberating the case.

Five of the major Japanese electrical firms and Oriental Infrared Ray Company have organized a committee to fight the ruling, demanding that a comparative study of the machines involved be made to clarify the point of infringement on Ransburg's patent. Three other firms were willing to pay royalties rather than go to the trouble of buying new domestic electrostatic coating machines.

Meanwhile, a Japanese representative of Ransburg Company said the company would forget about payment of royalties for past use if the Japanese firms would come to an agreement for the use of the patent in the future. Industry observers here said the Japanese firms will have to pay royalties sooner or later because Ransburg's Japanese patent has long been established.



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After setting for 30 minutes, the bond formed by one drop of Eastman 910 Adhesive supports a load of 5,000 pounds.

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An Open Letter

to Design Engineers regarding Dayton Rubber Improved Urethanes

by C. M. CHRISTIE, President, The Dayton Rubber Company

THE fabulous Urethanes are the most versatile new products since Nylon. Their possibilities are almost beyond comprehension.

We know, because we have been pioneering new Urethane formulations for many years. And the farther we go the more startling become our discoveries. The things DR *Improved Urethanes* can do are positively explosive in terms of new products and processes.

Today, DR *Improved Urethane* formulations . . . controlling weight, strength, density and texture . . . can be made at will. *We are the only company that covers the full spectrum of Urethane formulations in America.* This means that we can fashion a Urethane formula to solve an almost limitless number of design problems.

Already, DR *Improved Urethanes* have been tailored to hundreds of separate and distinct applications ranging from toys and topper pads to motor mounts and missile parts.

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Daycollan*, our solid Urethane, is compounded and cast to custom specifications and supplied as a finished mechanical component. All Daycollan has the common properties of high energy absorption, exceptional Shore hardness, tear strength and abrasion resistance.

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We have prepared a Urethane Technical Notebook . . . the most complete and comprehensive of its kind. In addition, we have an inspiring new book titled, "Headquarters for New Ideas" . . . a fast moving report on what HNI has done in the past and what it can do for you right now. Both of these pieces are profitable additions to your files.

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Write to me on your letterhead, and I'll see that you receive both of these fascinating and informative books about Dayton Rubber's **"Headquarters for New Ideas", and the fabulous possibilities in DR Improved Urethanes.** Write today. Executive Offices: The Dayton Rubber Co., Dayton 1, Ohio. West Coast inquiries should be directed to American Latex Products Corp., Hawthorne, Calif.

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WHAT HAPPENS TO PATENT APPLICATIONS?

THE U S PATENT OFFICE FOLLOWS A STANDARD PROCEDURE WHEN HANDLING YOUR APPLICATION. HERE'S AN INSIDE VIEW OF THE PROCESS.

THEODORE L BROWN
examiner, Division 66
U S Patent Office*

Every day of the year some 200 inventors or their attorneys lovingly seal their "flashes of genius" in stout manila envelopes and send them off to whatever fate the US Patent Office may hold. Only about three in five of these will ever be patented and inventors must often wonder why. Perhaps they would be consoled if they knew some of the reasons.

PRELIMINARY SEARCH

"Prior art" plays a vital role in any application and the attorney, or his Washington representative, will often make a search for patents on similar inventions to be sure the invention is original and patentable. All of the nearly 3,000,000 US Patents are divided among over 300 broad classes (pipe couplings, woodworking tools, etc) and over 50,000 sub-classes. The search is eased somewhat by this classification system, but still may be rather extensive if an invention belongs in more than one class.

Results of this preliminary search will establish whether a patent application is justified.

APPLICATION

The Application Branch of the Patent Office acknowledges receipt of an application at the time it is filed, and records it. The papers are inspected to see that they comply with formal requirements of a complete application. If there is a deficiency, the applicant via his attorney is so notified and the papers are held for completion.

A complete application includes: a petition or a request for a patent; a specification, with a description of and claims to the invention; an oath, usually combined with the petition on a standard printed form; a drawing, if the invention can be illustrated; and a filing fee of $30, plus $1 for each claim in excess of 20. Note that there has been no change in filing fee in 166 years.

If the application is complete, the written portion is placed in a manila jacket or file wrapper, the application is given a serial number and filing date, and is indexed on file cards. The drawing is inspected by the Drafting Branch for compliance with formal rules and standards, and then the entire application is sent to the particular examining division having charge of the same class of invention.

An application spends its most critical time in the examining division, for there the question of patentability is decided. Examination is to determine compliance with requirements of law and procedure, set forth in: the Patent Statutes, 35 US Code; Patent Office and court decisions interpreting and applying the statutes; the Rules of Practice; notices and memoranda issued by the Commissioner of Patents; and the Manual of Patent Examining Procedure.

A typical examination follows a regular routine. The papers are scanned briefly to determine that all formal requirements have been met. For example, a check is made to see that the inventor's name is spelled consistently in the oath, petition, and on the drawings. The examiner determines whether the oath is complete and is sworn to within a reasonably short time before the filing date of the application (approximately five weeks is satisfactory). Any claim of priority of filing an application in a foreign country, which arises with foreign applicants, is noted. The examiner also checks whether any formal objection to the drawings were made by the Official Draftsman of the Patent Office.

Then the specification and claims are studied to see that they are prepared according to the Rules, to learn the subject matter of the application, and to determine whether the invention is clearly and completely disclosed and claimed as required by Section 112 of the statute, 35 US Code. Vague and indefinite phrases and ambiguous terminology are noted and the applicant will be asked to clarify these passages. At this time the drawings are

*This article is the product of the author and in no way represents the official position of the U S Patent Office.

WHAT HAPPENS TO PATENT APPLICATIONS?

CONTINUED

also studied for clarity and completeness—different parts must be labeled with different reference characters, and every feature of the invention recited in the claims must be shown in the drawings.

Clear disclosure in both specification and drawings is basic to the point system. In exchange for a patent monopoly the inventor must clearly explain his invention to the public. Also, the public is entitled to know the precise limits of the patented invention, what similar inventions may be made, used, or sold during the life of the patent that are not exclusively reserved to the inventor, what may be licensed under the patent, and what will fall into the public domain at the expiration of the patent.

35 US Code 112. Specification.

"The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

"The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention . . ."

During the study of the specification the question of utility must be decided. There are many grounds for holding that an invention lacks utility (if the subject matter is frivolous, fraudulent, or against public policy) but the most common ground is inoperativeness. Each invention is analyzed to determine whether it is within known scientific principles and theories. In simple cases a careful examination of structural linkages or the like will settle the question. A device for perpetual motion would violate the basic principle of dissipation of energy. Similarly, energy in the form of light cannot pass through a wire if no conversion of energy, such as photoelectric conversion, has been made.

By far the most time is spent in examining claims, for in the parlance of the courts, "The claim is the measure of the invention"; they alone define the limits of rights granted with the patent. A claim is a summary, in one sentence, of the boundaries of the exclusive field of the invention to be reserved to the inventor, and recites the correlated chemical or structural elements, or method steps, comprising the invention. By the statutory requirement, a claim must particularly point out and distinctly claim the subject matter regarded as the invention.

For example, a claim to a two-tined fork would satisfy the requirement well if it were worded:

"A fork having a handle, and two parallel tines integral with and extending from the handle" rather than:

"In combination, a manipulating device comprising an operatively engagable portion in association with a plurality of work engagable members."

Assuming a fork with two tines would be patentable, the former wording has a much better chance of being held valid in court proceedings. The latter wording is in terms of desired result rather than positive structural elements, and is so broad as to apply to a screw-adjustable piano stool, a pair of pliers, or even a screwdriver lying on a bench next to ("in association with") a vise.

Each claim is studied to determine what is not, as well as what is, recited in the claim. All variations of the invention and all equivalent subject matter must be envisioned by the examiner to aid in the search of the prior art patents and other printed documents. The claims must be searched in their broadest aspects, for that is the way the inventor would wish them interpreted in the patent and it is certainly the way competitors of the inventor would wish them searched. The search covers US and foreign patents, books, magazines, maps, advertising brochures, catalogs, and other printed material. Often, related fields become apparent as the search progresses. All pertinent references are carried back to the examiner's desk and arranged according to the specific features disclosed.

Now the examiner must determine patentability of the invention over the teachings of the prior art. An invention is unpatentable if it was identically disclosed in a single prior patent or publication, and also (35 US Code 103) if the differences between it and the prior art are such that the invention would have been obvious to a person having ordinary skill in the art. In some instances this determination is easy: the mere substitution of a flathead screw for a roundhead screw would not ordinarily involve invention.

35 US Code 103. Conditions for patentability; non-obvious subject matter.

"A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains . . ."

In others the decision is more difficult, especially if the invention seems to be the result of gathering various separate elements into one device.

Two basic problems complicate this determination. First, the examiner is not likely to be a person having "ordinary" skill in the art, and must not lightly shrug off what would seem obvious to him, or must not be overawed by something not obvious to him. Second, the examiner must understand the scope of the invention, and

then must forget what he has learned and place himself in the position of a person having ordinary skill in the art.

As a result of the examiner's analysis and search, a letter goes to the applicant via his attorney. This "office action" cites the best references as well as those which the examiner regards as of interest. Some claims may be allowed or some or all may be rejected for various reasons. One ground of rejection, when based on a reference, is that the claims are obviously fully met if the reference is identical to the invention as defined in the claims even though not identical as described in the specification or shown in the drawings. Another ground is that the device as recited in the claims finds its full equivalent in a reference not identical to the invention, where an element in the reference is equivalent to that in the claim.

REJECTED CLAIMS

Claims can be rejected for reasons other than unpatentability over the prior art, and a brief summary of the more common reasons will show some of the difficulties of claim drafting:

In this country only subject matter enumerated in the statutes is patentable; all other subject matter is rejected as not being within the statutory classes of a new and useful process, machine, manufacture, or composition of matter. These would include a mere arrangement of printed matter, a thing occurring in nature, a method of doing business, or a scientific principle not embodied in any tangible structure.

Because of interests of national defense, no patent may be granted for an invention useful only in the utilization of special nuclear material or atomic energy in an atomic weapon.

As noted above, in the second example of a claim to a fork, a claim cannot be merely functional.

A common rejection is that of indefiniteness, where the claims include alternative or negative expressions, terms with no antecedent, indirect limitations of preceding terms, inferential rather than positive recitations of elements, and the like. This latter rejection covers the clear definition of the limits of the patent grant, one of the most important aspects of the patent system.

A product ordinarily may not be defined by the process of making it—it must depend on its own component parts for patentability, for if the product is old it may not be repatented merely because a new way of making it is discovered, although the new method of making it may itself be patentable. Conversely, where the invention lies in an article of manufacture, any claims to the method of making the article, if such method would be obvious from the article, are rejected as drawn to such obvious method.

A claim is rejected as incomplete if any essential elements, steps, or structural cooperative relationships of elements are omitted, especially at the point of novelty.

A rejection on the ground of aggregation is similar, where there is a lack of cooperation between the elements and no real cooperation has been recited.

Claims that have long recitations of unimportant details, obscuring the invention, are rejected as prolix.

Claims broadly drawn to an old combination of elements such as a carburetor with a gasoline engine, where the novelty lies only in the carburetor, are rejected on a reference showing the exhausted broad combination of a carburetor and engine.

35 US Code 102. Conditions for patentability; novelty and loss of right to patent.

"A person shall be entitled to a patent unless:

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the US, or . . .

(e) the invention was described in a patent granted on an application for patent by another filed in the US before the invention thereof by the applicant for patent . . ."

As previously noted, an invention having no utility is rejected on that ground.

Claims drawn to subject matter barred by statute, especially 35 US Code 102, such as an invention in public use or on sale in the US more than one year prior to the filing date of the application, are rejected.

Other grounds of rejection, such as multiplicity or nonstatutory claims, are less common than the above and need not be enumerated.

Claims may also be objected to for various technical reasons, rather than rejected.

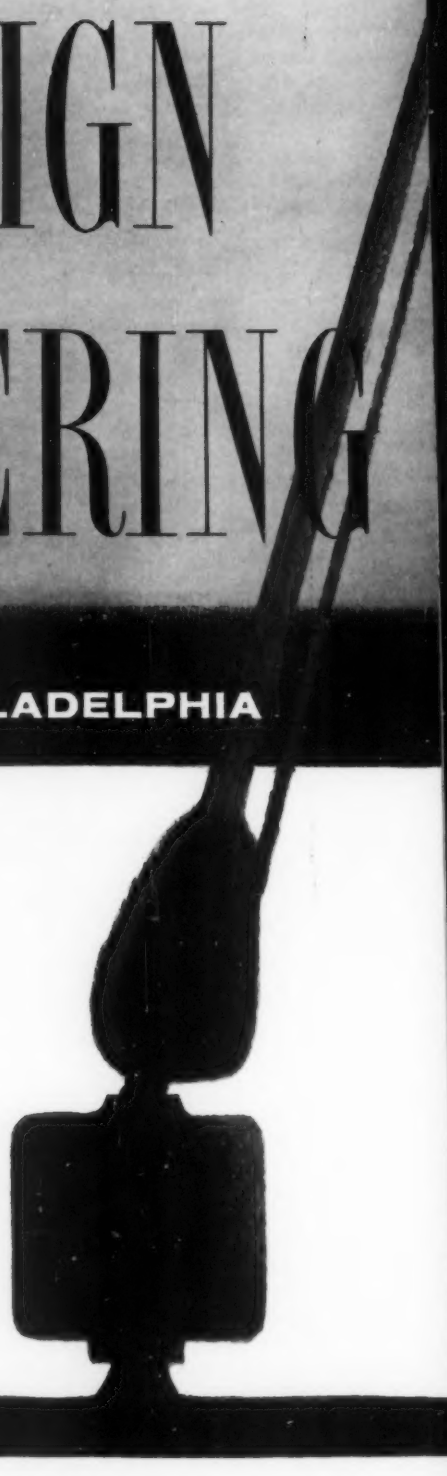
The applicant or his representative must respond to every ground of rejection set forth in the Office Action within a statutory period of six months and, by amendment of the claims accompanied by arguments, must attempt to overcome the various rejections. The examiner reconsiders the question of patentability in view of the amendments and argument, and may repeat the rejections or make new rejections on technical grounds or prior art discovered on a latter search. The applicant must respond to the new rejections, the examiner reexamines the application, and so forth until the claims are allowed or finally rejected by the examiner. If all the claims are allowed a patent is issued upon payment of the final fee of $30.

If all or some of the claims are finally rejected, the applicant may abandon the case (which can also be done during the early prosecution, by a letter of abandonment or by failure to respond within six months), or may appeal to the Patent Office Board of Appeals to have it review the propriety of the final rejection. The case may be prosecuted beyond the Board of Appeals to the courts.

Many other problems are encountered, such as the procedure followed when an application claims more than one invention, or when two people file separate applications for the same invention, but they are too complicated to be covered here. Information may be obtained from the Office of Information Services of the Patent Office: in the pamphlet "General Information Concerning Patents," (single copies are distributed free on request to the Commissioner of Patents); in the Rules of Practice of the United States Patent Office; and in the pamphlet of Patent Laws (both sold by the Superintendent of Documents, Government Printing Office, Washington 25, DC for 50¢ and 30¢ respectively); and in various other governmental and nongovernmental publications. ■

1959 DESIGN ENGINEERING

CONVENTION HALL • PHILADELPHIA



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MAY 25 • 28, 1959

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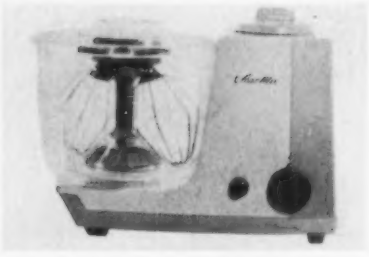
IDEAS
Your eyes will be opened to thousands of applications, suggestions, demonstrations, that can spark new thinking – speed your designs to a successful conclusion.

TRENDS

Germa

FOO

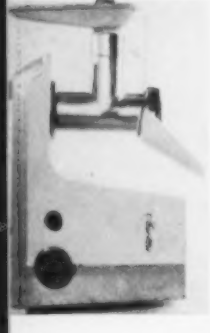
Ready for shredding



Ready for mixing

Food mixers and blenders are often combined into single units in Germany by manufacturers such as Electrostar GMBH, Reichenbach-Fils. In this latest model, designed by Goertz, New York, the usual overhead arm is eliminated, and the beaters are driven from below, making it easier to add ingredients during operation. Accessories (see smaller photos) are available for shredding, juicing, ice-cream making, meat grinding (here, entire motor stand turns 90° onto its back). Mixer takes up to 5 lb of dough, blender up to 2 quarts liquid. Housing is die-cast aluminum, bowls are heat-treated glass. Mixer speed 300 rpm; blender, 16,500 rpm.

Turned 90° for grinding



Juicing attachment fits into blender socket

n appearance design . . .

Soviet

ACHINES

COMPARED

Ready to mix dough

Coffee-grinder attachment

This food and beverage mixing-blending machine recently went into mass production at the Krasnaya Presnya Works, Moscow. Like the German appliance of the same type on the facing page, a single motor drives all accessories—apparently also at two different rates of speed. Among the kitchen chores performed are whipping, shredding and cutting, juicing (at left), meat grinding, potato peeling (device not shown), coffee grinding, dough mixing, blending.

Ready to cut vegetables

With meat grinder in place

POINTS OF VIEW

THE QUESTION:

How Satisfactory Are Pre-employment Company Examinations for Engineers?

DR FLOYD L RUCH
president
Psychological Services Inc
Los Angeles

"They are not as good . . .

as some quacks say, but they are better than some old fogies think. Tests, properly used, tell the employer—sooner by the calendar, quicker by the clock and at a great saving in headaches and in money—what he will untimately find out the hard way if he hires engineers without using tests.

"Through an adequate testing program, the hopelessly incompetent engineers can be passed up. But more important still is the use of tests to guide the employer in making assignments. A good testing program will help the employer recognize the engineer who is long on creative ideas but short on ability to do routine drafting. Tests will discover the man with sales or management potential. Through testing, the 'lone wolves' can be segregated from the sociable 'yackers,' so work and space assignments can be made more effectively.

"Last but not least, the individual engineer who has been thoroughly tested before being hired or assigned to a particular program feels that management is taking an interest in him as a person—and likes it."

CARL OSTLING
director of engineering
US Rubber Co

"Engineers trained in the knowledge . . .

of rubber practices are not available in the market. Thus, our pre-employment examination of engineers develops into a study to determine how well the applicant's background, with respect to his technical education, experience and personality, can be adapted to our specific endeavor.

"Our engineering supervisors are all men with 15 to 30 years of experience in the rubber industry. We believe they are in the best position to judge the applicant's potential capabilities as an engineer in their respective fields. The candidate fills out an application blank, and is interviewed by the engineering supervisor and the assistant director or director. The interview is informal—we do not depend on any prearranged list of questions; the sole purpose of the meeting is to judge the applicant's potential value as a member of the department. Our turnover with respect to incompetence has been outstandingly low. It sounds old fashioned, but we think it works."

VIEW

"Tests have proven to be effective selection tools . . .

Our follow-up studies indicate a significant relationship between the test scores of engineering applicants, their grades in company training classes, and subsequently their managers' evaluations of their performance. We believe that tests can improve the effectiveness of selection when used along with personal interviews and a review of the applicant's education and experience. By using tests in this way we have assured applicants a more complete evaluation.

"If a man received good grades in engineering school and has poor test scores, we would consider it important to find out why. Were the academic standards at the school he attended relatively easy or had he studied hard in order to get good grades? If the interview indicated that the latter was the case, we would evaluate the applicant as someone who might do better on the job than his mental ability score indicated, or as the psychologists would say, an 'over-achiever.' Similarly, a combination of high test scores and low or average academic standing may indicate the individual who might not perform on the job as well as his mental ability score indicated, or an 'under-achiever.' Of course, these results could also indicate other types of individuals, such as the socially active person who had been busy with campus extracurricular activities.

"The point is that the comparison of test scores with past achievement opens up interesting possibilities for exploration during subsequent interviews. Exploring these areas usually provides further insight into an applicant's personality and motivation. For this reason, testing makes an important contribution in helping us to evaluate applicants more completely."

W R GRAVES
director of employment & personnel services
International Business Machines Corp

"If done scientifically . . .

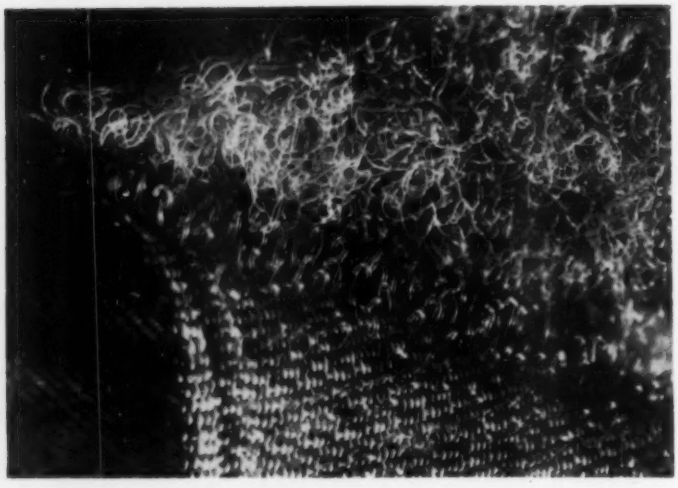
we have found that pre-employment examinations do assist in determining whether or not a particular individual is likely to be successful in a particular type of work. Tests are very effective in contributing to the selection procedure by their assistance in pointing out potential abilities and weaknesses in prospective employes, by identifying talent in individuals with little or no previous industrial experience. We have also used them to assist in evaluating an applicant's experience background, for example, or to provide clues in areas which are then explored at greater length in the interview.

"Pre-employment examinations as yet have not been perfected to the point where they can stand alone, particularly in the areas of motivation and personality. We feel they should be administered by trained people and the results interpreted only by professionally competent personnel.

"I wish to emphasize that scientific pre-employment testing is not an employment panacea; rather, it is but one step in a sound personnel-selection procedure. Testing must be integrated with a systematized recruiting program, a thoughtfully devised application form, adequate job analyses and job descriptions, and a sophisticated and mature interviewing team. Only when these conditions are met can we expect pre-employment testing to make its greatest contribution."

J R ROBERTSON
chief, personnel & general services, Engineering Div.
Chrysler Corp

SIGNIFICANT COMPONENTS MATERIALS PROCESSES



Intermittent drive unit . . .

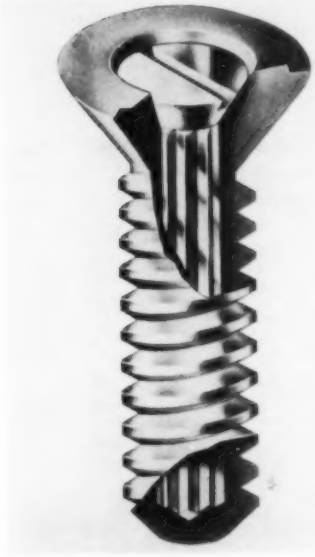
provides intermittent motion from a constant source of rotary power. All parts are enclosed in oil bath housing. Single package unit gives precise control of any intermittent motions desired, clip and bend, shear or slash, oscillate or repeat, raise or lower, index and position. Can be installed easily, needing only electrical connection. Hand- or foot-operated equipment can be mechanized with this unit, existing power-operated machines can be automated, and new equipment may be designed using unit as a building block. Flexible control, manual or mechanical or electrical, permits demand-type operations in fixed or variable cycles. Standard unit is $289. From stock after June 10. **Hilliard Corp, W 4th St, Elmira, NY.**

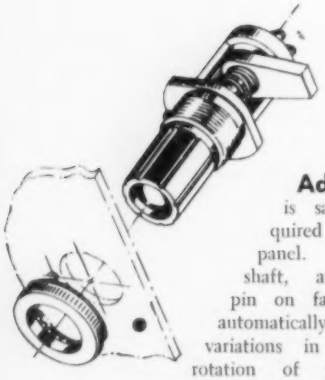
Circle 13, Reader Service Card

Press-to-close fastening . . .

consists of two masking strips of nylon tape, one covered with close-packed filaments, 500 to 600 per in., tipped with minute hooks; the other, covered with soft loops of multifilament yarn. When lightly pressed together, hooks and loops engage, creating an adjustable and secure closure. To open, strips are peeled apart. Stress is distributed over a large area, rather than at specific points. Currently available in ¾, 1, 1¼ and 2-in. widths and in white, black, light-ceramic-medium and navy blue, pink, red, beige, brown, light and slate gray. May be sewn, glued or stapled, or treated for heat sealing or pressure-sensitive application. Applicable in electronic equipment, industrial filters, reusable packaging, conveyor belts, home appliances, automotive and marine equipment. Cost ranges from 50¢ to $2 per yd, depending upon width. 25-yd roll is min order. Request on letterhead will bring free sample. **Velcro Sales Corp, 681 Fifth Ave, New York 22.**

Circle 11, Reader Service Card





Adjustable pawl fastener . . .

is said to eliminate rivets or bolts usually required to hold fastener body to door of panel. One $\frac{7}{16}$-in. dia hole takes fastener shaft, another 0.082-in. dia hole receives stop pin on fastener to prevent rotation. No. 48 fastener automatically adjusts pawl position to accommodate variations in frame thickness up to ¼ in. Continued rotation of plastic and steel knob increases applied pressure. Supplied in three types for frame thicknesses up to ¼ in., ¼ to ½ in. and ½ to ¾ in. Two knob styles are offered or fastener can be supplied with flatted shaft for use with any knob having a ¼ in. hole. Available from stock. **Southco Div, South Chester Corp, Lester, Penna.**

Circle 12, Reader Service Card

Composite plastic screw . . .

with metal core is said to combine insulating properties and strength of the two materials. Standard unit combines serrated steel core with threaded nylon body. Metal core carries torque applied by driving means. Screw is said to be self-insulating to eliminate vibration and corrosion problems, and to be self-locking. Can be supplied in colors. Offered in sizes 6-32, 8-32, 10-32, ¼-1, and ¼-20. Price ranges from about $6.45 to $36 for 1000, depending on size. **Austin Screw Products Co, 4873 W Armitage Ave, Chicago 39.**

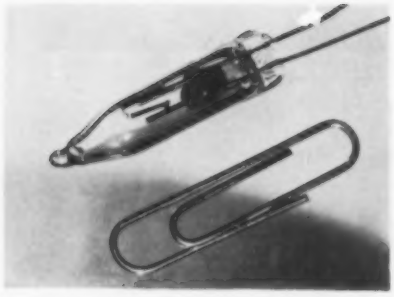
Circle 14, Reader Service Card

Resilient silicone potting compound . . .
is a fluid that can be poured into electronic components or subassemblies and gelled in place to form a transparent, self-sealing cushion. Properly catalyzed and cured, it develops into a soft, colorless, jellylike mass that is moisture resistant, thermally stable and has dielectric properties comparable to electrical grade silicone fluids. Curing time ranges from 30 min to 48 hr at temperatures from 104 to 302 F. Delicate parts and connections potted with this compound are said to avoid damage by stresses common to rigid potting materials subjected to fluctuating temperatures. Temperatures to 392 F under confined conditions are said not to affect properties of cured gel. Circuits can be located visually and checked by inserting test probes into the silicone gelatine, which reseals itself when probes are removed. In addition to filling and potting applications, compound can be used as damping material. Product is offered from stock for evaluation. Introductory prices range from $7.50 to $11.40 per lb, depending on quantity. **Dow Corning Corp, Midland, Mich.**

Circle 15, Reader Service Card

Fibrous silicone rubber . . .
somewhat resembles sponge and foam in properties. Silicone rubber fibers are randomly oriented into a mat said to have tensile and tear strength superior to silicone sponge and foam. Properties include high permeability, density in the range of 20 lb per cu ft, good compression-deflection characteristics and a useable temperature range of —65 to 500 F. Presently available from stock in sheets ¼ in. thick x 9 in. wide x 6 ft long. Samples are available. Introductory price is $8.50 per sq ft. **Connecticut Hard Rubber Co, 407 East St, New Haven 9, Conn.**

Circle 16, Reader Service Card

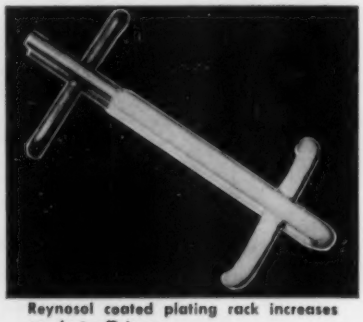


Subminiature circuit breaker . . .
is vacuum sealed in glass envelope about the length of a common pin. Device, measuring 1⅛ in. long x ⅜ in. dia, is controlled by time and temperature. Unit interrupts current flow when excessive current or external heating occurs. As temperature decreases or overload is removed, current path is automatically reset. Sensor is bimetal thermal element. Suited as overload protector for low-current motors having stall current below 10 amp, as an inexpensive thermal switch and in numerous other applications calling for low-cost circuit protection with automatic reset. Breaker can be operated at 12 to 115 v, with max current of 5 amp. Trip time ranges are 7 to 40 sec at 75 F and 3 sec min at 180 F. No-current trip temperature is 200 F min. **Sylvania Lighting Products, Div of Sylvania Electric Products Inc, Salem, Mass.**

Circle 17, Reader Service Card

Thermostatic actuators . . .
produce mechanical power from a small change in temperature. Special materials expand as temperatures increase, forcing a molded synthetic rubber plug into a reduced diameter in piston guide. This, in turn, multiplies movement of piston by extruding action. Piston movement is used to operate a valve disk, mechanical linkage or electric switch. Piston moves against force of return spring, causing return action and reforming thermostatic materials as element cools. Plug and diaphragm seal made of synthetic compositions. Elements are produced in sizes from miniature to lift a 30-lb load ¼ in. to large elements capable of moving 250-lb load ½ in. Temperature control ranges can be obtained between subzero and 450 F. **Detroit Controls Div, American-Standard Corp, 5900 Trumbull, Detroit 8.**

Circle 18, Reader Service Card



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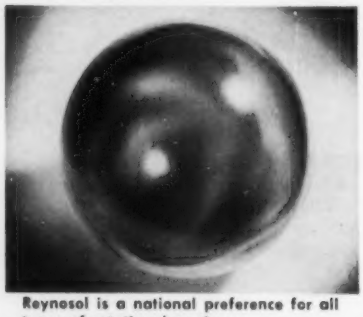
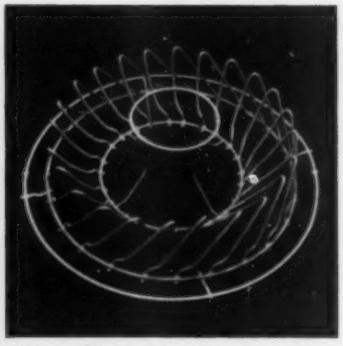


Reynosol is a national preference for all types of rotational castings.



Years added to life of automatic dishwasher rack with Reynosol coating.

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SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .

Lock with paddle handle . . . protrudes when door is not securely closed and is flush when locked. Designed primarily for use on truck bodies or metal cabinets, it can be spotwelded or bolted into place. Lock is thin and can be used on left- or right-hand doors. Available with single lock bolt for one point contact or two lock bolts for double contact, with or without keys. Key lock cylinder is in recessed position. **Podl-Lok Co, 1530 Wood St, Oakland 7, Calif.**

Circle 19, Reader Service Card

High-speed diode switch . . . is a multijunction, two-terminal germanium switch, rated 200 milliw, that can transfer from a blocking to a conductive condition in fractions of a microsec. In operation, diode is triggered by short-duration trigger pulse, which can be of less than 1 microsec duration, and of sufficient magnitude to insure raising voltage on device above breakwater voltage. To turn off, voltage must be reduced momentarily to zero, or the current through device must be reduced below min sustaining current. Available in four breakover-voltage categories ranging from 50 to 200 v. **Westinghouse Electric Corp, PO Box 2088, Pittsburgh 30.**

Circle 20, Reader Service Card

Epoxy-fiberglass tubing . . . with high tensile and burst strength, as well as optimum electrical properties, can be used by itself or in combination with inner and outer layers of other materials, such as vulcanized fiber and metal foil. Tubing consists of roller tube of glass fabric bonded with high heat-resistant epoxy resin. Tubing available in broad range of diameters from $\frac{1}{8}$ to 11 in. ID with wall thickness from 0.010 to $5\frac{1}{2}$ in. Max ratio of wall thickness to inside diameter is 1:2. **National Vulcanized Fibre Co, 1059 Beech St, Wilmington 99, Del.**

Circle 21, Reader Service Card

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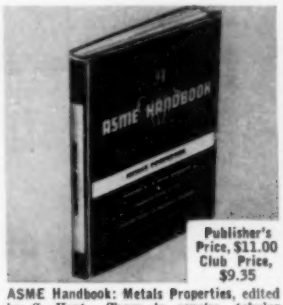

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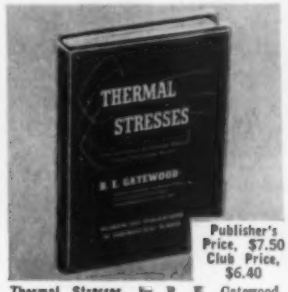

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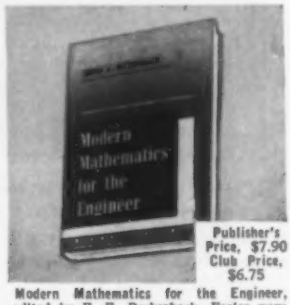
Thermal Stresses, by B. E. Gatewood. Methods for solving design problems caused by elevated temperatures.



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PE-4-20

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This single universal joint in a ribbon-stripping machine was operated at a 34° angle. The joint heated up, wear was excessive. (Curtis Joints have been tested at angles up to 37°, but we do not ordinarily recommend angles greater than 30°.)

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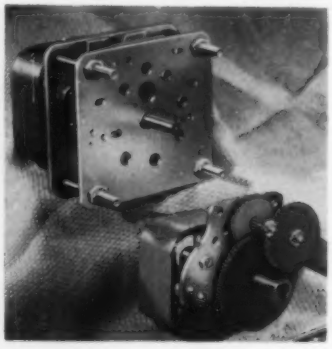
Circle 22, Reader Service Card



Unidirectional geared motors . . . in two types are especially suited for use in automatic vending machines. Single-plate geared motors are said to be used most frequently because of their starting torque, low cost, small size and rugged construction. Where there is a radial thrust load or torque requirements are beyond range of single-plate gear motors, double-plate gear motor is recommended. Double-supported gear shafts run in sintered bronze bearings lubricated with extra large oil wicks. Four sizes of unidirectional nongeared motors are also offered, with starting torques up to 0.7 lb-in. Barber-Colman Co, Rockford, Ill.

Circle 23, Reader Service Card

Microminiature tantalum . . . capacitors said to do job of conventional devices 1000 times their size (3/1000 cu in.) in electronic circuits where capacitors store and control flow of electrical energy. Device has a core of sponge tantalum, 0.1 in. dia x 0.3 in. long, produced by sin-

design engineers

Be sure to get your free **Urethane Technical Notebook**—the most complete available. For full details read the **Dayton Rubber** advertisement on . . .

page 32

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tering compressed tantalum powder at more than 3600 F in vacuum furnace where pressures are equal to those encountered 400 to 500 miles up in space. Rated capacity of device is said to be equal to that of conventional units 8 in. long x ½ in. dia. Units, now in production, meet standards of Industrial Preparedness Study and are offered in four sizes, ranging from 0.125 in. dia x 0.250 in. long to 0.341 in. dia x 0.750 in. long. They operate at up to 60 v. **General Instrument Corp, Newark, NJ.**

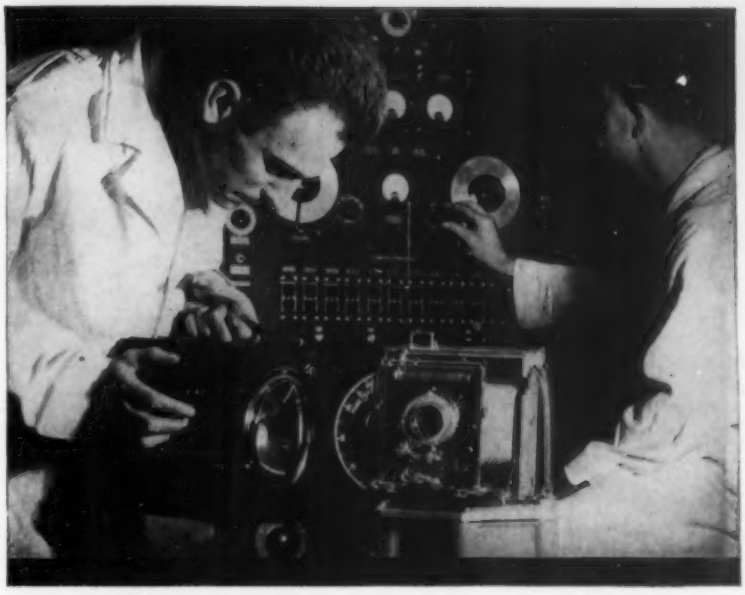
Circle 24, Reader Service Card

Adjustable limit-switch arm . . . may be varied to fit any specific application, permitting switch to be mounted safely out of path of moving pieces. Built for use on heavy-duty limit switch, arm consists of roller portion fastened to length of ¼-in. key stock, which in turn is inserted into section fastened to switch. Key stock may be cut to any desired length. Applicable to machine tools and various types of automation equipment. **Square D Co, 4041 N. Richards St, Milwaukee 12.**

Circle 25, Reader Service Card

Sprayable coating . . . of high-density polyethylene can be applied to metals and glass. Coating is said to have continuity, good adhesion qualities on a variety of surfaces, impact resistance and flexibility on metal surfaces, and is available in clear and a variety of colors. Coating may be applied at room temperature by various conventional coating methods. Coated part is subsequently heated to about 400 F for a few minutes to fuse coating and bond it to surface. Suggested uses include industrial process equipment, tanks, drums, automotive parts, appliances, marine equipment and electrical insulation. Now available in semi-commercial quantities. **Koppers Co Inc, Pittsburgh 19.**

Circle 26, Reader Service Card



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here's PROOF of how the GRC method cuts the cost of small parts...

Compare the methods for producing these mutilated gear, cam and bushing combinations . . . for an electrical appliance timer. (Shown actual size)

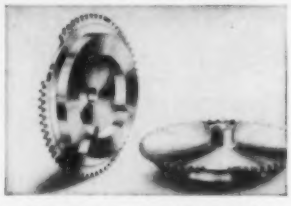
*method A

* Stamping, screw machine part, assembly.

- Blanked, pierced, & extruded Cam
- Blanked & pierced Gear
- Screw Machined Bushing
- Sub-assembly: Stake Bushing to Gear
- Final Assembly: Stake Cam to Gear

5 PRODUCTION STEPS + 5 Inspections

the GRC method



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- Ready to use as cast
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SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .

Hydraulic power unit . . . utilizes compact wafer motors to drive pumps of from ½ to 30 gpm at pressures to 2500 psi. Said to achieve high performance for small package. Aluminum reservoirs and brackets achieve heat rejection and durability without rust or corrosion. Pump location under reservoir oil is said to maintain quiet operation. Ac and dc units are offered with all types of attachments. Unit shown has external line filter and adjustable relief valve. **Spencer Hydraulics Inc, Racine, Wis.**

Circle 27, Reader Service Card

Hydraulic flowmeter . . . is said to measure accurately even when fluid viscosity varies from 100 to 750 ssu. Meter may be used to check volumetric efficiency of pumps and circuits by using fluid filter housing to hold flow meter. Available in five max capacities, from 10 to 200 gpm, operating under vacuum and pressures to 5000 psi. Flow meters with housings are offered for installation on hydraulic test stands, power units and in bulk liquid transmission operations. Limit switches may be added to indicate changes in flow rate. Rate of flow is read from graduated control wheel, in gpm. **Rosaen Co, 1776 E Nine Mile Rd, Hazel Park, Mich.**

Circle 28, Reader Service Card

Multipurpose lubricant . . . is said to have application in 90% of all ball and roller bearing installations. Also for plain bearings, needle bearings and on rotating and sliding surfaces. Lithium-base product is said to have high film strength with excellent water-repellent properties, to be unaffected by short or long exposure to damp atmospheres or direct contact with water, to have absorptive properties, and to be smooth, non-fibrous, homogeneous and odorless. Operating temperature range is 0 to 275 F; melting point close to 400 F. Made in six densities to meet various applications. **Keystone Lubricating Co, 3100 N 21st St, Philadelphia 32.**

Circle 29, Reader Service Card

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NEW LITERATURE

Modern Jupiter

JOHN ANDERSON MILLER. ASME, 29 W 39th St, New York 18. 5½ x 8½ (paperbound), 228 pp. $4.

Basically, Charles Proteus Steinmetz' life is the success story of an immigrant who arrived in the United States in 1889 and achieved world-wide renown as the first maker of artificial lightning. Unfortunately, as Miller tells it, his life seems too pat, his problems too quickly and simply resolved.

Steinmetz was born physically deformed and this deformity obviously played an important part in his way of living. Because of it, he never married, finding the much needed family love by "adopting" and residing with his laboratory assistant, his wife and children. How did his lonely life affect his work and ideas? He loathed the chores of administrative duties, preferring to work alone on a single project.

Steinmetz held many interesting philosophies for his day. His dabbling in politics should serve as an example to all people with a famous name—don't, unless you know how. Steinmetz' isolationist speeches could have done far more harm to his name than it actually did. In one respect he was lucky. McCarthyism was unknown and a scientist could present unpopular political beliefs without losing his job.

From an engineering standpoint, the scientific philosophies of Steinmetz are hardly scratched in *Modern Jupiter*. His law of hysteresis is barely mentioned and his mathematical teachings are regretfully omitted. The scientific world still needs a complete account of Steinmetz. —BAL

The "Maximum" Manager

Stating that technical management is different from other types of management in objectives and techniques used, an attempt is made to determine the essentials of the job.

"The Maximum Manager in Research and Development," M A Williamson, Pennsylvania State University, IRE paper 5.1, 1 E 79 St, New York 21.

TITANIUM—Brochure, 36 pp. Discusses the conversion of basic ore into sponge and melting of sponge into ingot form. Covers strength, weight, high-temperature performance, fatigue strength, corrosion resistance, erosion resistance and thermal properties. Includes rating chart on corrosion properties; specs and characteristics of various titanium alloys; design data; weight tables, manufacturing limits; tolerances; machining and joining; applications. Harvey Aluminum, 19200 S Western Ave, Torrance, Calif.

Circle 1, Reader Service Card

PRODUCT RESEARCH AND DEVELOPMENT—Booklet, 12 pp. Covers areas in which the company renders service. Includes such topics as product research and development, product improvement, product application, comparative testing and market research. Foster D. Snell Inc, 29 W 15th St, New York 11.

Circle 2, Reader Service Card

INSTRUMENTS FOR RENT—Bulletin GEA-6829, 8 pp. Describes instrument rental program. Discusses scope of program and other pertinent factors involving more than 13,000 instruments. General Electric Co, Schenectady 5.

Circle 3, Reader Service Card

ELECTRONIC RACKS—Catalog 59, 24 pp. Descriptions, specifications and construction details of cabinet racks, chassis and panels. With illustrations and cutaway views. Par-Metal Corp, 32-62 49th St, Long Island City 3, NY.

Circle 4, Reader Service Card

Letterhead Requests Only

Manufacturers who published following literature ask that requests for copies be made on company letterheads.

CAMERA SELECTOR—Folder, 4 pp. Describes 27 motion picture and sequence data cameras for use in engineering research and a plan by which they may be rented by day, week or month. Each camera is illustrated and includes operational and performance data and rental rate. Set up in tabular form. Traid Corp, 1713 Ventura Blvd, Encino, Calif.

REVERBERANT ROOMS—Technical data, 6 pp; Bulletin AN-33, 18 pp. Information on acoustical and structural characteristics of reverberant (anechoic) rooms, as well as typical applications. Booklet on "Anechoic Rooms" discusses design considerations and features of units. Industrial Acoustics Co Inc, 341 Jackson Ave, New York 54.

design engineers

Be sure to get your free **Urethane Technical Notebook**—the most complete available. For full details read the **Dayton Rubber advertisement on . . .**

page 32

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Publisher's Postscript...

BOUND TO PLEASE

Four months ago, in a Postscript on this page, I asked you to write in telling us what you thought about perforated pages in a technical publication. Your response was overwhelming—nearly 1500 cards and letters deluged our Readers Service Manager—and the vote was clear: 86% for perforated pages, 14% against.

But, as happens so frequently, the minority was quite vehemently against. "Perforation will encourage readers to remove pages, therefore later readers won't get a whole issue," they said. Engineering department librarians were particularly disturbed at the prospect.

I think we can satisfy everyone. Look over next week's (April 27) issue. You'll notice there are no staples holding the pages together. The publication, when open, lies flat clear to the binding edge. This type of binding, which might be called stitchless, adhesive binding, is known as "Perfect Binding" in the printing trade. It has been experimented with for years, but they could never find an adhesive that would hold under rough handling. Now we have a formula that really works—one that penetrates various kinds of paper stock, remains flexible, yet holds securely.

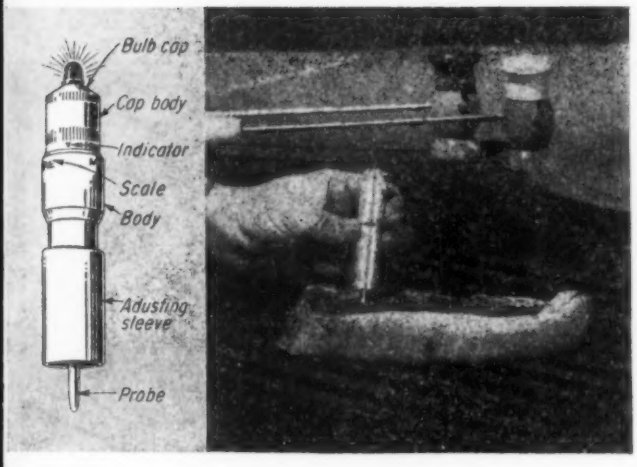
With this type of binding the pages are permanently bound in—there is no suggestion of easy removal such as with perforations—yet pages can be neatly and easily torn out, right to the binding edge, with a little care. There are no staples in the way.

Starting with next week's Design issue, all Design issues will have this binding. If experience and reactions from you indicate that we have made a worthwhile improvement, we'll continue. Later on—after we have had sufficient experience under normal publication production conditions—if it appears that this new binding is popular, we may also bind the R & D issues in the same way.

If you like this binding, or if you don't like it, we'd appreciate your opinion after you've examined next week's issue. It costs more money so, naturally, we want to be sure it's worth while.

—AH

For Your Information (personal)



Bad Cooks—Good Steaks

A bimetal contact and a rheostat hooked up to a signal bulb and battery are designed to answer clearly and unequivocally the burning (steak) question: Is it done enough? Just set the calibrated knob to "rare," "medium," or "well-done," insert the probe in the meat, and the light provides the answer. No guesswork. No temperatures to read. The device is calibrated so that when the probe is subjected to temperatures previously determined to be those of rare, medium, and well-done meat, a contact is made and the bulb lights up. Scott Thermo-Meter Corp, 1190 Brooks Ave, Box 26, Rochester 19, NY, makes it; and it's available by mail order from John Surrey Ltd, 11 W 32nd St, New York 1, for $3.98. The name, appropriately enough: *Steak Test'r.*

Making those slides slide

Remote-controlled slide-changers are the latest aids for the harried speaker. Following in the footsteps of the TV manufacturers, optical-equipment makers are now offering both cord and cordless ("ultrasonic") devices for shifting from one view to the next. Leica has a corded control which permits focusing as well as slide-changing by means of "a little black box held in the hand." It is standard equipment with the Pradovit F Leica model, priced at $163.50. A cordless, ultrasonic unit is sold separately. It consists of a "silver tube placed beside the projector; plus two rubber, hand-held "horns" that control the slide-changing and focusing." This device is said to be effective at a considerable distance—even from another room. It's priced at $150. E. Leitz is the American distributor.

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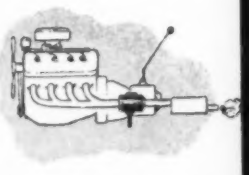
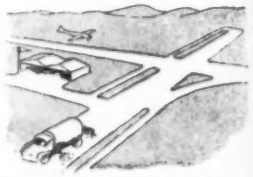
Why Don't They R and D EVELOP . . .

Here are five inventions needed by the armed forces. If you've got an idea about how they may be designed, type it out and mail to: The National Inventors Council, US Dept of Commerce, Washington 25, D.C. Keep a carbon for your files.



. . . a moisture scavenger which removes water from combustion products of internal combustion engines to prevent formation of ice fog—a common problem when stationary engines are used in low temperature climates. In automobile manifolds it would trap water before it collects in mufflers and tail pipes—preventing rust-out. Must not increase exhaust back pressure or otherwise affect engine performance.

. . . a zero-leak coupling for nuclear power plant piping. Even very small leaks can be dangerous if fluid is radioactively contaminated. Pipes are welded at present; but this is too slow. Carefully made O-ring flanges have been tried but are not sufficiently trustworthy. Coupling must seal against water, steam and other gases at 1000 to 1600 psi and 500 F. Method must be applicable for pipes with 10 to 12 in. diameter.



. . . a chemical which will melt snow or ice but will not have a corrosive effect on metals. Will be used on runways in arctic areas to melt thin layer of snow and ice which remains after plows have removed the bulk of the snow. Calcium chloride works, but is corrosive. Heated sand is too cumbersome to handle and too difficult to prepare. Both have been used but neither is very effective at −65 F.

. . . a non-magnetic compass, small enough to be carried by a foot soldier. It must indicate true north within an accuracy of 5 mils and operate independently of the earth's magnetic field.

. . . a continuously variable transmission for driving generator at constant rpm from variable-speed power source such as an automobile engine. Must be small, lightweight and inexpensive. Useful as an efficient means for developing constant frequency ac or constant voltage dc without voltage regulators, dynamotors, etc.

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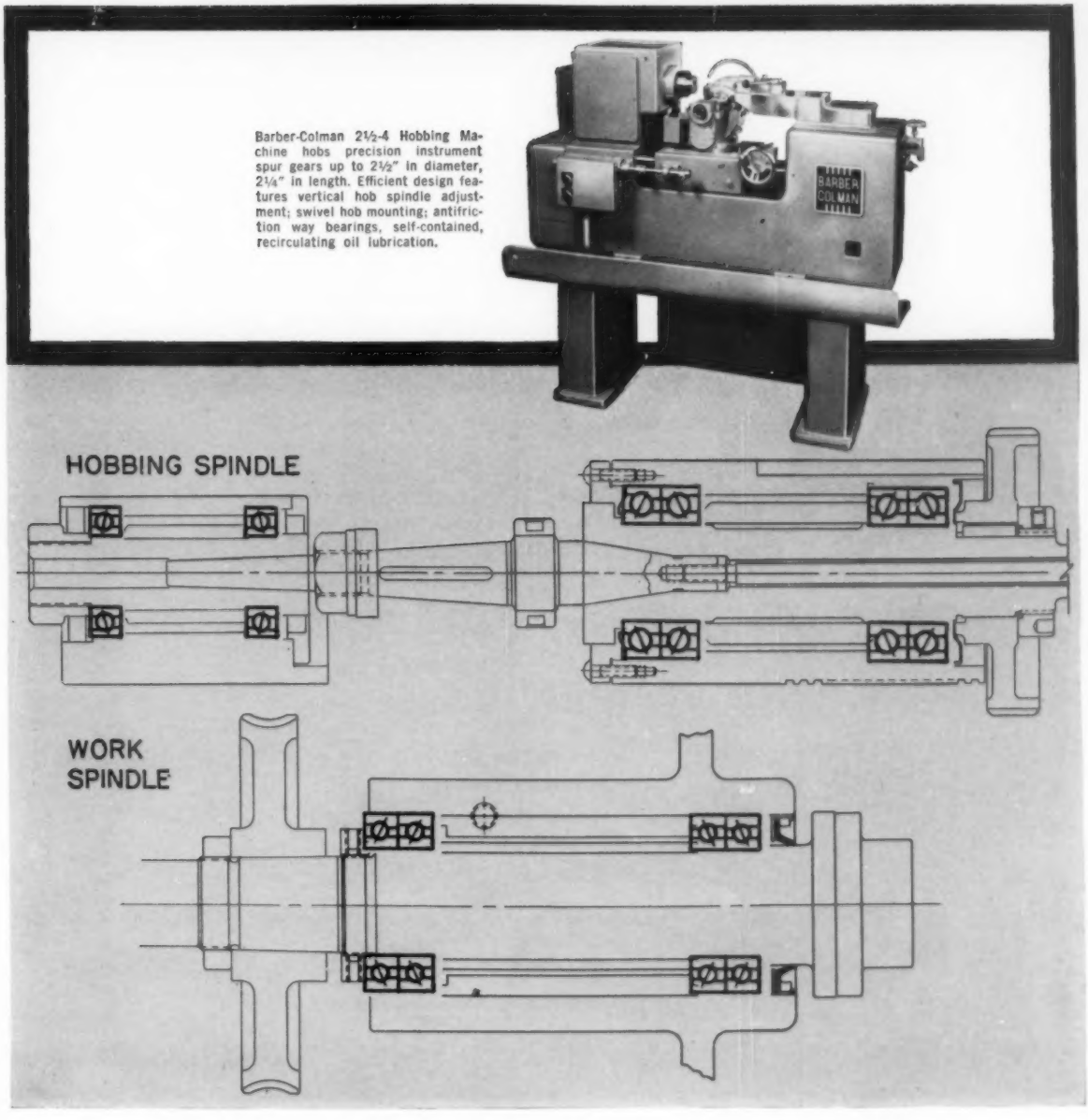
Barber-Colman 2½-4 Hobbing Machine hobs precision instrument spur gears up to 2½" in diameter, 2¼" in length. Efficient design features vertical hob spindle adjustment; swivel hob mounting; antifriction way bearings, self-contained, recirculating oil lubrication.
BARBER COLMAN
HOBBING SPINDLE
WORK SPINDLE

Relative rotation of hobbing machine spindles held accurate within 20 seconds using Fafnir Ball Bearings

New Barber-Colman 2½-4 machine precision-hobs spur gears for instruments

If two words can sum up the design of Barber-Colman's new 2½-4 Hobbing Machine, they are *accuracy* and *rigidity*.

Developed for hobbing AGMA Precision Class 3 fine-pitch spur gears for guidance systems, the 2½-4 has a minimum number of parts at points where deflection or inaccuracies might occur.

In selecting bearings which would complement the accuracy of the gears in the machine, Barber-Colman designers got the performance they wanted with Fafnir super-precision ball bearings. Single row, extra-light, counter-bore types, eight used in duplex pairs, help maintain indexing accuracy within *20 seconds*.

The application is typical of thousands Fafnir has handled where performance requirements put an extra premium on bearing selection. Chances are, Fafnir experience — plus breadth of line — can answer bearing problems you may have. Write The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR
BALL BEARINGS

10 Fafnir Extra-Light Super-Precision Ball Bearings, snug fit, support the Barber-Colman 2½-4 machine spindles. 4 variations, equipped with composition retainers, are available in this one series to meet specific load and speed requirements where exceptional rigidity is wanted.

basic snap-action switches

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more answers to switching problems

- quality engineered designed to meet human factors
- over 60,000 switch and actuator variations available
- adaptations can be made to fit your requirements

tiny switches? LOOK AT THESE...

sub-sub-miniature

actual size

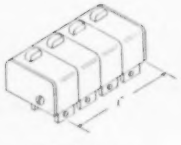
T series

SPDT

Only .526" L. x .250" W. x .323" H. No dead break, perfect for super-sensitive uses. High repeatability, only one moving part besides button. Rugged construction withstands extreme shock and vibration.

Amb. Temp. T-3 −65° to +250° F.
T-7 −65° to +350° F.

Elec. Rating: 7.5 amps @ 125/250 V.A.C.
7.5 amps Res. @ 30 V.D.C.
3 amps Ind. @ 30 V.D.C.



gang in min. space w/close-tolerance mtg.

A3-59/T-3

A5-71/T-3

A5-73/T-3 roller leaf

new designs on the boards, send us your requirements

sub-miniature

actual size

E4-100 series

SPDT

L.W.H. 25/32" x .250" x 23/64"

Elec. Rating: 5 amps @ 125/250 V.A.C.
4 amps Res. @ 30 V.D.C.
2.5 amps Ind. @ 30 V.D.C.

Operating Force 150 grams max.
Amb. Temp. −65° to +250° F.
E4-107 −65° to +350° F.

Variety of termination and operating characteristics. For switches meeting Military and U.L. approval, write for details.

A3-32/E4-103 maintained

A3-47/E4-103 momentary

A4-14/E4-103

A4-15/E4-103 adj. move. diff.

A4-82/E4-103 removable plastic button

A4-87/E4-103 alternate action

A5-10/E4-103 roller leaf

A9-7/E4-103 rotary

moisture proof? SEE HERE...

miniature

ENVIRONMENT FREE

actual size

EF-100 series

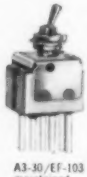
SPDT

L.W.H. 7/8" x 11/32" x 19/32"

Elec. Rating: 5 amps @ 125/250 V.A.C.
4 amps Res. @ 30 V.D.C.
2.5 amps Ind. @ 30 V.D.C.

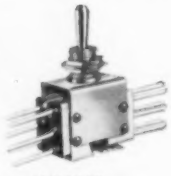
Operating Force 5 to 17 oz.
Amb. Temp. −65° to +180° F.
EF-105 −65° to +350° F.

Termination, 12" of 20 ga. wire epoxy resin sealed. Enclosed basic switch conforms to MIL-S-6743, with entire unit meeting MIL-E-5272A.

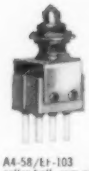


A3-30/EF-103 maintained

A3-38/EF-103 momentary



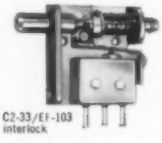
A3-51/EF-103 momentary, 3 position (center off)



A4-58/EF-103 roller ball, cam act.

A5-59/EF-103 leaf

A5-103/EF-103 roller leaf



C2-33/EF-103 interlock

Need a special switch?

Often standard switches can be modified to do the job. If a special switch is required, Electrosnap engineering can create new switches in any quantity to your specifications. Send us your problem ...our answer can save you time and money.

Call Or Write For Specific Details On Any Switch Type

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SWITCH DIVISION • 4246 W. Lake Street, Chicago 24, Illinois

Telephone: VAn Buren 6-3100, TWX No. CG-1400